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VOL. XLIX. No. 1.

ARCHIVES OF OPHTHALMOLOGY.

SUGGESTIONS REGARDING THE TEACHING OF OPHTHALMOLOGY.[1]

BY DR. F. H. VERHOEFF, BOSTON, MASS.

ALL of us will agree, I am sure, that the training of ophthalmologists up to the present time has been highly unsatisfactory. The men have been thrown largely upon their own resources, compelled to teach themselves and, above all, provided with imperfect facilities for so doing. To have been compelled to teach themselves has not been altogether unfortunate, and I think that in the future also the most eminent ophthalmologists will continue to be largely self taught, but I hope that their tasks will be rendered easier and that they will reach still higher standards than in the past. It will never be possible "to make a silk purse out of a sow's ear" and one of our endeavors at the outset should be to exclude the unfit and attract men of natural ability into our specialty.

The suggestions that I have to make on the teaching of ophthalmology are based partly on my experience as a teacher, and partly on my experience in the practice of ophthalmology. As a teacher I have acquired certain views in regard to methods of instruction, as a practitioner, my own needs as well as those of colleagues have indicated to me some of the subjects that should be taught.

[1] Read at meeting of Section on Ophthalmology, New York Academy of Medicine, October, 1919.

Students requiring or desiring instruction in ophthalmology divide themselves into four main groups, namely, (a) The medical undergraduates; (b) The general practitioners who desire to take up the practice of ophthalmology; (c) The practicing ophthalmologists who desire to make up deficiencies in their training; (d) The recent medical graduates who desire to qualify themselves for the practice of ophthalmology. I shall discuss the problems relating to the instruction of each of these groups in order.

(a) The medical undergraduates: I shall not discuss at length the undergraduate course in ophthalmology since it has but little value to the students who are later to take up the practice of this specialty. In the cases of certain of these students it could, perhaps, advantageously be dispensed with and other courses substituted. It is pertinent, however, to remark here that the undergraduate course should give the students such a comprehensive though general view of the subject that they will realize what an interesting branch of medicine ophthalmology is, and that its mastery requires a thorough knowledge of all the fundamental principles of medical science. If the undergraduate students are thus impressed a larger percentage of high grade students will no doubt decide upon an ophthalmological career.

(b) The general practitioners who desire to take up the practice of ophthalmology: Usually they are men who have failed in their profession or have become tired of it, and have turned to ophthalmology not because of any special liking for this specialty, but because they regard special practice as an easy way to make a living. Many of these men are imbued with the idea that they can become competent ophthalmologists by taking a six weeks' post-graduate course. Under present conditions they cannot very well be excluded from these courses, but when there are established postgraduate schools of ophthalmology worthy the name they should be compelled to take the complete course therein. In this connection I may add that in my opinion it is not desirable for a man to take up general practice before beginning the practice of ophthalmology. For, while I would not say that the time so spent is entirely wasted, it can certainly be employed otherwise to far greater advantage.

(c) The practicing ophthalmologists who desire to make up deficiencies in their training. Since at present there are no qualifications required for special practice, other than a license to practice general medicine, there are ophthalmologists of all possible grades in this country. Many of them are unworthy of consideration and should be excluded from special practice, but others through natural ability and industry have developed into able practitioners. Many of the latter, finding themselves deficient along certain lines, take special courses offered at various medical schools or hospitals, and more of them would do so if such courses were adapted to their needs. In any scheme of ophthalmic instruction provision should, if possible, be made for these men. However, this should not be done if it interfered in any way with the regular curriculum of the graduate school. No doubt after the latter had become thoroughly established, this problem would solve itself by the process of evolution. Perhaps such courses can be limited to the summer months. In the future probably the demand for them will gradually diminish or disappear as the new set of ophthalmologists reach the ascendancy in numbers.

(d) The recent medical graduates who desire to qualify themselves for the practice of ophthalmology: From the standpoint of its significance to the community, I regard this as the most important problem connected with ophthalmology to-day. For upon the character of the training of the ophthalmologist largely depends the service he will render the community, not only as a practitioner, but also as an investigator and teacher. The attempt of the American Board for Ophthalmic Examinations to set up a minimum standard of qualifications for the practice of ophthalmology is most praiseworthy, but under present conditions it seems to me it is almost like placing the cart before the horse. For if the minimum requirements were set as high as they should be, few of the candidates would be able to meet them owing to the impossibility of obtaining the necessary instruction. It is, therefore, of prime importance that schools should be established for such instruction. These schools would not only make it possible to place the minimum standard high, but would ultimately raise the standard of the leaders of ophthalmology. Since the younger men would strive to emulate the leaders, the general standard

of ophthalmology in this country would rise to a higher level.

The following plan that I have to suggest for a graduate school of ophthalmology will no doubt be found far from perfect. I feel, however, that it is something to build upon, and will be perfected by the process of evolution or trial and error, if put into execution.

PLAN FOR GRADUATE SCHOOL OF OPHTHALMOLOGY.

Requirements for admission:

(a) A degree from an approved medical school which requires for metriculation at least two years of collegiate work. A four years' college course is not insisted upon because in many cases this would unreasonably prolong the time before the beginning of practice. The college work, however, should include courses in higher algebra, plane and solid geometry, trigonometry, physics, and chemistry. A reading knowledge of French and German should be recommended if not required.

(b) Such practical clinical experience in general medicine, surgery, dermatology, syphilology, oto-laryngology, and neurology, as can be obtained in the out-patient clinics of a large general hospital within six months. It should be allowable for the student to divide this work, taking three months' work in the summer before entering the school, and three months' work the following summer or the summer after the hospital year.

In place of requirement (b) there may be substituted,

One year's experience as pathological interne or assistant in pathology at an approved hospital or medical school.

Or, one year's experience as assistant in physiology at an approved medical school.

Or, one year's experience as interne in an approved general hospital.

I have purposely made these requirements elastic because I believe it not desirable to attempt to cast, as it were, all the students in the same mold. By allowing students to follow their own inclinations as far as possible they will later be better able to specialize in certain subjects connected with ophthalmology and as research workers to contribute materially to the advancement of ophthalmic science.

I feel strongly that the students should be discouraged from accepting interne-ships in general hospitals. While no doubt they learn, in this way, better than in any other, a few things that will later be useful to them, they do so at too great a sacrifice of time and energy. During this period, when they are best able to acquire new knowledge, they are seeing a very limited variety of cases, are almost out of touch with the ophthalmic viewpoint, and are too fatigued by the stress of routine work to read or to permit their original ideas to come into play. Moreover, they are learning many things that will not be of the slightest value to them in special practice. On the other hand, in a large out-patient clinic, they become familiar with a great variety of conditions which may later present themselves in connection with their special practice.

PLAN OF INSTRUCTION.

The course would lead to the degree of Doctor of Ophthalmology (Oph.D.) and occupy two years. The first year, to be known as the academic year, would be devoted both to clinical and laboratory work, and in the case of specially qualified students, to a certain amount of research. During the second, or hospital year, the student would be required to serve as ophthalmic interne or assistant in an approved hospital.

The academic year: The student each morning would follow the practical clinical work of the hospital from 9 A.M. to 12 M., three days a week attending the out-patient clinic and the other days attending the operations and studying house cases. In this way the student would be kept in touch with clinical work throughout his course. This would make all of the work more interesting and significant than otherwise would be the case, and at the same time enhance his clinical knowledge. Moreover, it is impossible to concentrate clinical teaching within a short period of time, since a sufficient number of cases are not available for this purpose.

The laboratory work would be carried on chiefly in the afternoons, and would be arranged tentatively as follows: Gross anatomy of the head, including the accessory sinuses, orbit, and central nervous system; normal histology and embryology of the eye, two months. Pathological histology, experimental

pathology, bacteriology of the eye, operative work on cadavers and animals seven months, three days a week. Physiological optics, errors of refraction, motor anomalies, perimetry, neurology of the eye, seven months, two days a week.

The Hospital Year: This should preferably follow the academic year. At first, however, it may be found advisable to admit students to the academic year who have already served ophthalmic interne-ships, or whose clinical experience is equivalent to this. At the end of the academic year a certain number of students, the exact number depending upon local conditions, would be selected on the basis of their work to become internes in the hospital connected with the school. The others would be granted certificates indicating that they had completed the academic year and would then have to seek interne-ships elsewhere. An attempt should be made to secure coöperation on the part of other hospitals so that these men could be appointed without examination. On the completion of the hospital year, the degree of Doctor of Ophthalmology would be conferred.

If as seems improbable, it should turn out that the schools of ophthalmology could not on this plan graduate a sufficient number of ophthalmologists to supply the country, it might be necessary to abandon the hospital year as a requirement for the degree.

METHODS OF INSTRUCTION.

The classes should be small, each consisting perhaps of only eight students. Large classes could not be taught satisfactorily in the clinic and it would be impossible for all the members to obtain interne-ships. On account of the small size of the class, instruction could be given throughout by demonstrations, informal talks, assigned reading, and recitations. Courses of didactic lectures although often pleasing to the student, are generally of little real value and should be employed only when instructors who are exceptionally gifted as lecturers are available. A certain number of special lectures, however, should be given by various members of the hospital staff upon subjects upon which they are particularly well qualified to speak.

The time assigned to the laboratory courses no doubt would have to be modified to meet local conditions. At the outset

the courses on the anatomy of the head and central nervous system, and possibly upon the neurology and embryology of the eye, may have to be given by the regular departments of anatomy, etc., in the medical school, on account of the impossibility of obtaining ophthalmologists qualified to give them. As soon, however, as graduates of the ophthalmic school can be obtained who desire to give these courses, it would be preferable for them to do so because they would have the ophthalmological point of view.

Research: At first no special provision for research work need be made. Until a student has received training equivalent to that afforded by the school it would be unlikely that he could conduct investigations of any real importance. Throughout the course the originality of the student should be fostered and students who show special ability and aptitude for research should later be appointed instructors in the school and permitted to carry on original investigations. Ultimately provision should be made for men to devote their entire time to investigation.

THE TEACHING STAFF.

This will no doubt present the most serious problem connected with the organization of the school. While almost all of the members of a hospital staff are willing to give a certain amount of time to clinical teaching, few are qualified to give such instruction as should be given and these few seldom can afford the necessary time and energy. Still greater difficulty will be encountered in obtaining teachers for the laboratory courses, for at present there are almost no men qualified to give them. Moreover, the men would have to sacrifice a large part of the time ordinarily given to private practice. The ideal solution of the problem would be to reorganize our hospital staffs so that they would include a certain number of men who devoted their entire time to hospital work and teaching. These men would have general charge of the teaching and would assign certain supplementary work of instruction to qualified members of the visiting staff. To begin with, however, the only practical solution, it seems to me, would be to select a number of younger men of special ability who would give a large part of their time to the work and teach themselves

at the same time they were teaching the students. These men should be as few as possible so as to allow for expansion of the teaching force later when graduates of the school became available. Obviously, the solution of this problem will be influenced by local conditions.

To inaugurate and maintain such a school as I have outlined, adequate funds would be necessary. Since the classes would be small it is manifestly impossible that the fees paid by the students would be sufficient for the purpose. The public desires efficient service from ophthalmologists and therefore should provide the funds to ensure it, either directly or indirectly through some benevolent individual. It is a noteworthy fact that while relatively large sums have been contributed to further the advancement of other branches of medical science, ophthalmology has been sadly neglected. This may be due to the fact that its needs have not been sufficiently advertised, and all of us should therefore endeavor to remedy this state of things. The altruistic tendencies of the public which were so strikingly displayed during the period of the German menace, have apparently gone almost out of existence with the latter. It will now no doubt be necessary to appeal to the selfish and even purely commercial instincts of the public. However, by pointing out the economic loss that results from impaired vision, a strong plea can be made for ophthalmology upon these grounds alone.

SOME SUGGESTIONS IN POSTGRADUATE TEACHING OF OPHTHALMOLOGY.[1]

By Dr. MEYER WIENER, St. Louis, Mo.

THE whole problem of what is most needed in postgraduate teaching rests upon the question as to how well qualified is the average physician starting in to limit his practice to diseases of the eye,—what preliminary training he has had, and with what experience, both theoretical and clinical, he has been endowed in his special branch. Napoleon once said that in making an attack upon the enemy, the main object was to make it a successful attack, and in order to accomplish this, one must need use all of his available material,—men, cannon, and horses, and that all must be used to the greatest advantage. Thus, a young man, in preparing himself for any special branch in the practice of medicine, including ophthalmology, must first of all be well versed in the groundwork of medicine, including the fundaments, such as anatomy, chemistry, physiology, pathology, etc. How can one expect to learn to take care of diseased tissues, unless he has a thorough understanding of their very life, growth, and living functions and reactions? It is not any more essential for him to be an *expert* in the physiological laboratory or chemical laboratory than it is for the general planning the attack to have a detailed knowledge of the placing, sighting, and firing of each gun. It is all-important, however, that the general should know the range and destructive power of his guns, just as it is for our student to have a good general knowledge of the fundamental

[1] Read at the meeting of Section on Ophthalmology, New York Academy of Medicine, October, 1919.

branches, so that he may summon his aids for help in emergency, or even in daily routine. In order to attain the greatest success he must utilize all of this knowledge acquired to the very best advantage. This point, I assume, is a generally recognized fact and can be passed over lightly.

There seems, however, to be a wide divergence of opinion as to what method of procedure shall be employed to best equip the specialist for his future life work. I am judging this from various sources—from the courses outlined in the medical school, undergraduate departments and postgraduate departments; from the special postgraduate schools and courses; and lastly, from the knowledge acquired from having been thrown in unusually close contact with a large number of practicing ophthalmologists at Camp Greenleaf. All of them were supposedly well qualified in their specialty, but a large proportion was sadly deficient in general groundwork, and a still greater number was lacking in many of the constituent principles making for careful and efficient work. To those who have had the exceptional opportunity of conducting the examination for the certificate of ophthalmology, given by the American Board of Ophthalmic Examiners, has been revealed, to an unusual degree, the ability to determine the fitness, acquirements, and restrictions of a certain class of aspiring ophthalmologists. There is lacking in this group, however, certain men, successful and otherwise, who for various reasons have not seen fit to come before this examining body, and therefore the field of judgment has been, in a measure, limited. To Dr. de Schweinitz and myself, however, and our corps of associate instructors at Camp Greenleaf, I feel that an unusual occasion was offered to judge the fitness and inherent qualifications of the ophthalmologists who were sent to camp for training. These men were taken from all sources and localities,—from Alaska to California; from Florida to Maine. Among them were thoroughly capable men with national reputations, as well as others who, though perhaps enjoying a large and lucrative practice, were wholly unfit for their work.

The average course in ophthalmology embraces the teaching of external diseases of the eye, their symptoms and signs, diagnosis and treatment, and errors of refraction and muscle work and the use of the ophthalmoscope in a more or less complete

manner. It also includes the various operations on the eye, and the usual operative methods employed. Some reach out still further and give a general outline of special anatomy, special physiology and pathology, and even, as in the University of Colorado, a course on physiological optics. The student is shown certain cases in the clinics, told, for instance, that this certain patient is afflicted with iritis, and given a talk on the symptoms of the disease and perhaps the differential diagnosis; and then treatment is outlined. Seldom is the opportunity given to the student to conduct the examination himself and arrive at a diagnosis after summing up his findings. I think that the most serious defect in the education of our ophthalmologists, next to the need of a fundamental education, has been the lack of a systematic method of examination of patients and training the power of observation. This includes not only external diseases, but ophthalmoscopic examination as well.

Our experience at Camp Greenleaf showed that practically no one entering the school could properly describe a fundus. I do not mean to imply that these student officers were unable to make an ophthalmoscopic diagnosis, for there were men who came to us who were as capable in general as perhaps any of the teaching staff, and much more so than some of them. But I maintain that they were not properly trained to accurately and systematically describe a fundus, which means that with such ability as they possessed, plus the proper system, they would have been even better men and perhaps have let fewer things slip by unnoticed.

For example, it was our custom to insist on the following routine in examination of the fundus:

(1) MEDIA: If opacities existed, describe location, size, and number, and if in the vitreous, whether fixed or floating.

(2) DISK: Its size, shape, color, outline, surface, excavation in detail as to size, depth, sloping or undermined walls, vessels perforating cup margins or following the sides; lamina cribrosa plain or obscured. Condition of scleral and choroidal ring, pigment deposits, etc.

(3) VESSELS: Size, actual and relative, color and contour, pulsation flexibility and reflex.

(4) LESIONS: Size, character, number and location, macular

region, foveal reflex, and periphery. It was impressed upon the student that in searching for lesions, he must follow some systematic method, such as following the four branches of the central vessels from the disk outward; a careful examination of the macular region and of the periphery, so as not to let any possible lesion escape notice. A case of fracture of the skull in a small boy was utilized to advantage before one of the sections, to demonstrate the importance of careful daily recording of the findings in detail, the disk outline being normal on the first examination, and showing progressive changes on each succeeding examination. In this case the first slight change was noticed within twelve hours after the first examination, before the report from the X-ray plate had been returned, making an almost positive diagnosis of fracture, confirmed later by the X-ray plate.

It has always been my firm conviction that after one or two cases have been demonstrated before a class, showing the method of routine examination, the students in turn should make examination of all other patients before the rest of the class, stating his findings as he progresses, and only guided by the instructor during the examination, so as to make certain that nothing is overlooked. In this manner the student gains self-confidence and reliance, while the attention of the rest of the class is held much closer, knowing that any one of them may be called upon to supply some point neglected by his brother student during the process of the examination.

If the student makes a routine examination of a patient, describing the general condition of the patient and in detail the appearance of the external lids, lid margins, sac, external muscular movements, width of the palpebral fissures, conjunctival surface of lids, retrotarsal fold, sclera, cornea, iris, pupillary reactions, tension, etc., how can he help but observe any and all pathological processes which may be present, and thus arrive at a correct diagnosis? For example, in describing the bulbar conjunctiva, it is required that he note not only redness, but the character of the redness, extent and location, etc., always impressing the necessity of systematic and careful routine. This point, to my mind, has been the one outstanding feature lacking in properly training our students of ophthalmology.

I am not offering a definite schedule for consideration, nor

am I urging a fixed plan for what is necessary as to length of time a course of study should continue in order to include all of the essentials for making a competent oculist. The schedule in force at Camp Greenleaf was most carefully worked out as to what could be offered in a given number of hours. A certain proportion was allowed for didactic teaching and the rest divided into practical work, such as refraction, muscle work, perimetry, examination of clinical cases, ward work, records, operations, etc.

I believe a course could be worked out with these same principles for a basis. First, that no one should be admitted to this course without proper credentials or credits, just as he would be compelled to present in entering an accredited university for a degree,—in lieu of which he should pass a satisfactory entrance examination.

A six months course should be given during which the student's time should be wholly occupied from five to six hours daily. For the first six weeks or two months he should receive his groundwork, such as anatomy, embryology, physiology, pathology, bacteriology, physiological optics, and theory of refraction and accommodation. The rest of the time should be devoted to practical work, under direction. This should include the final working up of cases from start to finish, making, for himself, any bacteriologic or pathologic tests, outlining fields of vision, careful refraction, and in fact, any and everything necessary for a proper understanding of the case. Impress upon him the necessity of keeping careful records and of properly indexing and cross-indexing his cases, so that they may be utilized to advantage. Some of us have felt the need of this greatly, and have been most seriously handicapped. Personally I plead guilty to being one who was poorly drilled in this most important matter, and of being compelled to work under tremendous disadvantages for many years.

The subject is too large for anyone to attempt to cover in a single effort,—my main purpose in this paper being an endeavor to bring out discussions from the many capable men present.

Successful results cannot be hoped for without a good foundation. I know that some will argue that it is not necessary for one to be versed in higher mathematics or physiological

optics to become a successful practicing ophthalmologist, and that it is practical knowledge we crave and not theory. I will admit that if one had but the choice of either, he must take the former. No one can deny, however, that a man well versed in both must be better able to cope with problems confronting him than one who has had only one or the other. Our aim should be to produce only the best. It is also most desirable that every effort should be bent toward not only preparing the postgraduate for successful practice, but to stimulate his ambition for research investigative work. Teach him how to train his power of observation in the laboratories as well as the clinics, in the matter of careful record notations. He should be taught in such a manner that he will think for himself and not have a fund of information dished out to him on a platter all prepared to be absorbed and digested which he is apt to promptly forget. This can be done even in the laboratory for physiological optics, as exemplified by the practical teaching in this branch conducted by Javal and Tscherning at the Sorbonne in Paris.

I remember my first experience on presenting myself to Professor Tscherning and telling him I wished to take his course. He started me in immediately by handing me a lens and asking me to find the focal distance. I placed a candle on the bench twenty feet away, measured the distance from the lens to the focused image, and handed it to him. He then placed the candle closer and said, "Find it now." The next problem was for me to find all of the images of the candle on the lens and tell which were real and which virtual. The same was done with plain, convex, and concave mirrors, and progressing from the simplest to the more complicated problems, always with the one idea of making the student think for himself, with the patient and learned and approachable Tscherning as the guiding spirit behind. If this can be done in a laboratory for physiological optics, similar methods can surely be adopted in any other kind of laboratory. In other words, we always come back to the one all-important and dominant idea in teaching—not to give a brilliant talk on a subject, but to train the student's power of observation and to make him think for himself. I think the method utilized by Dr. de Schweinitz of using lantern slides in his analysis of ocular diseases to be ideal,

as it enables the student to both visualize with his sense of sight, as well as hearing, in acquiring theoretical knowledge, which he will later be more easily able to apply in a practical way.

There have been many opinions expressed as to the reason for the annual pilgrimage of American medical students to the clinics and universities abroad. I think the concensus of opinion agrees that it has been chiefly due to the high specialization, especially amongst the Germans, the subsidizing of whose universities by the Government permitted medical men to take up scientific investigation with remuneration almost commensurate with that which they would receive in practice. Thus, one could go to Axenfeld in Freiburg, Leber in Heidelberg, Wintersteiner and Salzman in Vienna, or Greef in Berlin for special courses in bacteriology or pathology—to Koenig in Berlin, or Tscherning in Paris, for special work in physiological optics—to Haab in Zürich or Hirschberg in Berlin for ophthalmoscopy or magnet instruction—to Fuchs in Vienna for general diagnosis and operative surgery.

In fact, one could select the special work which he felt most necessary, and then choose from several places, the course he found best fitted to his needs. Not alone that, but he could go to a large center, such as Berlin or Vienna, and find a special course in almost any branch of highly specialized subjects at almost any season of the year. What have we here in this country to offer as a substitute? There are some fairly good postgraduate courses given in several of our large cities. These, however, are usually given only once during the year and are general in character. There are very few exceptions.

I believe it would be feasible to increase the number of exceptions in all of our large university centers by proper educational propaganda. We already have authorities on physiological optics in Denver, pathology in Boston, plastic surgery in Detroit, and a few others we could mention. Can we not formulate a plan to utilize the large universities, such as Harvard, Hopkins, Washington University, and others, as well as the Wills Eye Hospital, Knapp Memorial, New York Eye and Ear, Massachusetts Eye and Ear, Illinois Charitable Eye and Ear hospitals, and others, in a concerted plan to establish highly specialized courses for the many desiring to equip themselves for practicing ophthalmology to the best advantage? I believe

that an association could and should be formed, consisting of the heads of the eye departments of the leading universities and institutions especially adapted for the purpose. This applies not alone to ophthalmology, but to the allied branches and fundamentals so necessary to acquire, in order to have a broad and proper understanding of our subject. I remember going to Vienna a few years ago and taking a special course in general pathology, internal medicine, skin diseases, and nervous diseases. I could have had anything else I had wished at the time. It is up to the medical departments of our universities to start something in general, or ourselves in particular. As Dr. Arnold Knapp has said, the time is ripe for careful consideration and action in postgraduate teaching of ophthalmology. We should endeavor to stem the exodus of students abroad each year and make this country the Mecca for medical thought and knowledge. We have the material, facilities, and teachers. What is most needed is concerted action in formulating or drafting a definite scheme of procedure and carrying it out with the same firm decision and steadfast determination which finally gave victory to us and our Allies in the great war.

SUGGESTIONS FOR A POSTGRADUATE COURSE IN OPHTHALMOLOGY.[1]

By Dr. ALEXANDER DUANE, New York.

CONTACT with ophthalmologists during the last quarter of a century has convinced me that not only is there imperative need of better and more thorough teaching of ophthalmology in this country, but, further, that there is a constantly increasing demand for it among the men who come to us for instruction. Our schools have been increased, our facilities have been enlarged, but, nevertheless, the supply has not kept up with the demand. The men who come to us for instruction demand more intensive work, more complete work, and, particularly, work that will occupy their whole time.

Hitherto this has scarcely been attainable except by private enterprise.

The ideal that we have to set before us to fulfill the wants so frequently expressed, is an institution which shall give the student full-time instruction, so graded and so coördinated, that he shall receive in four or five months' time, the instruction that is now spread over a year, and shall, moreover, get that instruction not in a haphazard way but in such fashion that nothing is omitted and nothing duplicated nor taken out of turn.

With regard to such an institution and the course it could offer, the following seem to me points worthy of consideration.

First, careful and thorough instruction in the fundamentals and in the theory of ophthalmological work must precede practical study. This principle, fully recognized in under-

[1] Presented in abstract at the Section on Ophthalmology of the New York Academy of Medicine, October 20, 1919.

graduate teaching, is of even more importance in postgraduate work. During the years in which I have been teaching ophthalmology I have had largely to do with men of rather mature age who had already been engaged in the practice of the specialty for some time. Such men have not the mental pliability nor the readiness to grasp abstract reasoning that the undergraduate has. The practical, they can easily take in; they are keen for clinical teaching and operative work; other things, less easy to them, they are apt to neglect unless these are insisted on. It is all the more important then that their theoretical deficiencies, which they find it rather hard to fill up, should receive particular attention. In fact, if there is one thing more than another that my teaching work has impressed on me, it is the necessity in the case of postgraduates of thorough drill in the theory of each branch of ophthalmology, before taking up its practical application. Thus a student should not begin to examine patients for glasses until he has had a thorough drill in the optical properties of lenses and of the other appliances used in refraction work and also in the optical properties of the normal and ametropic eye; nor should he begin to make examinations with the ophthalmoscope until he has had sufficient optical training to understand the principles underlying the working of the instrument in all its applications and also sufficient training in the anatomy and pathology of the eye to comprehend the nature of the appearances and the lesions he encounters. Again he should not undertake to test patients for disturbances of motility until he has been carefully drilled in the anatomy and physiology of the muscles and nerves, understands the various types of eye-movements, how they are produced, and how measured, and has studied the theory of their derangements. So, too, operative work is not taken up until by didactic teaching and laboratory work, the student has become well informed as to the anatomy and pathology of the eye.

In its entirety, this principle cannot be applied to the study of external diseases, because, in a short course, the student to cover the extensive ground of clinical work must see patients from the start. Here a middle course is advisable, *i.e.* for the first half of his period of instruction and while he is pursuing the other elementary courses, the student should see in the main only

selected cases, and his observation of them should be fortified by didactic instruction and by quizzes. On this plan, during the first two weeks when he is learning the anatomy and histology of the exterior parts of the eye, he takes up mainly diseases of the conjunctiva and lids. On these his instructors give him short practical lectures before demonstrating the patients. On the contents of these lectures he is quizzed and of the cases themselves he is expected to render case reports, which are criticized by the instructors. Through the succeeding weeks this program is carried on, the student studying successively diseases of the cornea, diseases of the uveal tract, glaucoma, and affections of the lens. At the end of this time (say, in eight to ten weeks) he is prepared to take up the study of miscellaneous cases, for which he is the better fitted because he has by this time had a good drill in laboratory work, in ophthalmoscopy, and in motility.

One essential point in the fundamental training that needs emphasis at the start is drill in what may be called methodology and also in the general principles of ætiology and therapeusis. Hence during the first two weeks the student should be schooled in the symptomatology of the eye, in the art of history taking, and in the practice of making examinations in external cases according to a systematic thorough routine. This is a point that I used to insist on in my classes, directing the students invariably to pursue a regular routine so that no detail should be omitted in determining the facts. In office work we cannot always do this with the thoroughness that we exact of our students. Sometimes, indeed, we fail because we are not thus thorough. But, however this may be, there is no question but that the student should be taught to make an examination that is absolutely systematic, thorough, and complete, so that, whatever else may be his deficiencies, he shall not miss any diagnostic point from failure to look for it, nor miss any symptom from failure to ask about it.

In the matter of general ætiology, the student should be taught at the outset the relationship of eye disease to systemic disorders and to diseases of other organs; and early, too, he should be taught the general principles of ocular therapeusis.

My second point to which I should like to call particular attention is that between this thorough drill in the elementary

theory and the unrestricted practical work, an intermediate step should be taken. In a paper just presented before the Academy of Ophthalmology and Oto-Laryngology Dr. Clarence Loeb has very rightly pointed out that our textbooks fail to assemble the facts in the form most helpful to the student. They give, that is, a description of a disease, its causation, pathology, and symptoms, but ignore the fact that what the tyro meets with is symptoms from which he has to unravel the cause. This defect was recognized in my student days and was remedied in certain of the quiz courses and occasionally in certain special textbooks. In these, groups of symptoms were assembled and analyzed and the various conditions that might cause them were given and differentiated. For instance, the various conditions likely to cause abdominal pain were tabulated and contrasted. Or, disease pictures were given and hypothetical cases, and from these the diagnosis was elicited. This, which we may call the preclinical course, because it paves the way for the examination of actual cases, is one of the most stimulating and helpful methods of teaching.

I may illustrate what I mean by showing what I used to do in ophthalmoscopic teaching. After drilling the men in the theory of the ophthalmoscope, and in showing the student what particulars he was to observe in the course of a systematic examination as regards the media, the disk, the retinal vessels, and the color and transparency of the retina and choroid, I would assemble for them, first, all the conditions that might cause a real or simulated change in the shape of the disk; next all the conditions that would make the disk hazy or indistinct; then, all the conditions making the disk paler or redder than normal, the conditions causing narrowing of the arteries or their distention, the conditions causing swelling and excavation of the disk, the conditions causing whitish areas, spots, or masses in the fundus, the conditions causing black spots, etc. This sort of drill, supplementing and correlating the study simultaneously made of the symptomatology of the diseases themselves, made the student ready to appreciate and keen to differentiate the various appearances that he was to see when he began to apply the ophthalmoscope.

In like manner, a whole series of questions can be framed which will call the student's attention to the possible causes

underlying any given symptom presented. Such questions are:

What conditions may cause contraction of the visual field and how differentiate them?

What conditions may cause a central scotoma?

What conditions are associated prominently with pain in the eye, and how tell them apart?

These and other like questions may be supplemented by supposititious histories, illustrating more or less typically cases of toxic amblyopia, syphilitic ocular paralysis, retinal detachment due to tumor, etc.

Students derive most advantage from such group questions and hypothetical histories, if these are given to them as problems for them to solve. This is a stimulating practice because it exercises their memory and reason and makes them learn at first hand how to differentiate like but not identical conditions. The student works out his problem as best he can, and his solution is afterward criticized by his instructor in the presence of the members of the class, each of whom adds his own suggestions. In this way each anticipates the clinical work to come later.

The third point that I should like to emphasize is the supreme importance of individual instruction. This means teaching small classes, each consisting as far as possible of men of approximately the same ability and training. The old West Point method by which students were divided into sections, according to their ranking, section A comprising the top men, section B the next, and so on, offers an example worth imitating, for in handling a homogeneous section there is much less time lost, and the better men are not held back by the less able.

In handling such sections I have found the best method that of alternate lecture and quiz, with frequent short snappy reviews. The teacher working in this way soon finds whether the men in the class are following him and what their individual difficulties are, and shapes his discourses accordingly. In the best sense of the word, he uses the argumentum ad hominem. By this personal contact and by the interchange of ideas involved in the method of question and answer, he is able to stimulate interest and excite enthusiasm better than in any other way that I know of.

All the preceding involves the thought of a definite sequence in the work. Unless such sequence is carefully provided for, there will be more or less duplication of work and some ground will be covered before the student is ready for it.

Following out these ideas I have framed the following outline of a short intensive ophthalmological course for post-graduates. This course is designed to cover four months (seventeen weeks). When possible the work is intended to be continuous during the year, and this may be effected either by having three consecutive or five overlapping courses. The latter plan (Plan A subjoined) is the better, if sufficient instructors are available. In this regard, as will be pointed out presently, a good deal of assistance is supposed to be derived from advanced students.

The students themselves while completing the course in seventeen weeks, should be encouraged to stay for a full half year, utilizing the extra nine weeks for advanced clinical and operative work, and for special study, varied according to their taste and capacity (*e. g.*, taking advanced work in physiological optics or perfecting themselves in laboratory technique). Such students should be particularly available as clinical assistants and as teachers and quiz masters.

On the other hand, in the course outlined, a man who could not afford to spend even seventeen weeks, could in three months (thirteen weeks) gain at least a good preliminary training in laboratory work, physiological optics, refraction and motility, and make a fair beginning in the art of examining and handling external cases and in the technique of operations. This work he could advantageously supplement later by reëntering and taking another three-months course, beginning where he left off.

For all classes of students the first twelve weeks of the course would be spent almost entirely in elementary work. During this time predominant stress would, at first, be laid on theory and methods, while later more and more time would be devoted to the practical application of the theory. In the last five weeks the work would be exclusively practical and advanced.

Furthermore by the free use of quiz and conference, by the preparation and criticism of case reports, and by the individual character of the teaching made possible through distribution

of the class in small, graded sections, the student would not simply be taught but would be educated in the true sense of the term, *i.e.*, would have his faculties of observation, comparison, and judgment gradually trained and brought out. To take one example of what I mean, the act of "viewing operations" would signify not simply looking on, but having the purpose and significance of what the operator was doing explained, and would imply also the taking of careful notes to be afterward criticized by the instructor.

During the period of advanced training (after the first ten weeks), the students, especially those entering for a half-year's work, would act as assistants in the clinic or laboratory and help in the teaching, *e.g.*, by quizzing the students of the succeeding section, by drilling them in refraction or in ophthalmoscopy, and in other ways. This would not only help to make good any dearth of instructors, but would be a great help to the men undertaking the work, for there is no question but that the very art of teaching a subject, recently acquired, confirms one's knowledge and clarifies one's ideas.

CONSPECTUS OF COURSE.

1. *Anatomy and Physiology of Eye.*—Lectures, demonstrations, and quiz. 1st and 2d weeks, gross anatomy and physiology of lids, lacrimal apparatus, conjunctiva and cornea; 3d and 4th weeks, uveal tract, lens, orbit, and sinuses.

   3 hours a week.

2. *Laboratory.*—1st and 2d weeks, histology of eye; 3d and 4th weeks, histology and embryology; 5th to 7th week, bacteriology; 8th to 12th week, pathology including X-ray diagnosis. Laboratory drill in sections, advanced students acting as assistants.

   6 hours a week.

3. *Optics and Theory of Refraction.*—(a) 1st to 4th week, physical optics; 5th to 7th week, physiological optics; 8th week, theory of refraction. Lectures, demonstrations, and quiz in sections.

   3 hours a week.

(b) Practice of refraction.—9th to 14th week. Advanced students act as assistants.

6 hours a week.

4. *Ophthalmoscopy.*—5th and 6th weeks, theory and methods; 7th to 12th weeks, practice. Advanced students assist in the teaching.

3 hours a week.

5. *Neurology of Eye.*—1st and 2d weeks, anatomy and physiology of retina, optic nerve, and central connections; 3d and 4th weeks, methods of neurological examinations; testing of pupil; 5th to 8th week, examination of cases.

3 hours a week.

6. *Perimetry and Color Testing (with testing of Light Sense).*—3d to 7th week.

2 hours a week; in 7th week, 4 hours.

7. *Motility.*—1st and 2d weeks, anatomy and physiology of muscles and oculo-motor nerve centers; 3d and 4th weeks, normal eye movements, monocular and binocular; 5th and 6th weeks, theory of derangements of motility, methods of examination; 7th to 10th week, examination of cases.

3 hours a week.

8. *Methodology.*—1st and 2d weeks, history taking, symptomatology, method and routine of examining external cases; method of making case reports.

3 hours a week.

9. *Ætiology and Therapeusis.*—1st to 4th week, ætiology of eye diseases, relation of diseases of eye to systemic affections or diseases of other organs; 5th and 6th weeks, therapeusis of eye diseases.

2 hours a week.

10. *Study of Symptom Groups and Hypothetical Cases.*—Problems in these matters set to students; criticism of solutions—3d to 7th week.

2 hours a week.

11. *Clinical Work (Elementary).*—1st and 2d weeks, cases mainly of diseases of conjunctiva and lids, and lacrimal apparatus; 3d and 4th weeks, diseases of cornea; 5th and 6th weeks, diseases of uveal tract; 7th week, glaucoma with instruction in tonometry; 8th week, diseases of lens and vitreous; 9th and 10th weeks, special cases, review, and examinations. Advanced students assist especially in demonstration of cases and in quiz.

6 hours a week, lectures and demonstrations.
3 " " " quiz on lectures and cases seen.
2 " " " discussion and criticism of case reports presented by students.

12. *Clinical Work (Advanced).*—11th to 17th week,[1] miscellaneous cases.
(a) Examination of cases, 10 hours (in 15th to 17th week, 12 hours) a week.
(b) Case reports, 2 hours a week (including reports on operative cases).
(c) Ward visits (13th to 17th week), 6 hours a week (this would also include operative cases).

13. *Operations (Elementary Work).*—8th week, principles of operating and antisepsis; 9th to 14th week, operations on cadaver and pigs' eyes.

5 hours a week.

14. *Viewing Operations.*—Demonstration of operative methods; quiz on operations seen; discussion of case reports of operations and cases operated on—8th to 17th week.

3 hours a week (8th to 12th week); 6 hours a week, (13th to 17th week).

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[1] For long-time students, 11th to 26th week.

15. *Advanced Operative Work.*—15th to 17th week.[1] Assisting at operations; dressing of cases; operations on living; ward visits and case reports (see under Clinical Work 12*b* and 12*c*).

5 hours a week.

16 *Teaching.*—11th to 17th week,[2] teaching and quizzing especially in refraction, ophthalmoscopy, and external diseases; assisting in laboratory and clinic.

3 hours (in 15th to 17th week, 5 hours) a week.

17. *Special and Advanced Work.*—Special work in laboratory, physiological optics, clinical work, or operating; research work—18th to 26th week in case of long-time students.

Hours by arrangement.

The courses of seventeen weeks each may be arranged according to two plans:

PLAN A

Plan A comprises five overlapping courses a year, each new course beginning ten weeks after the preceding.

(Allows 4 weeks' vacation—one week at Christmas, 3 weeks in September or August.)

The successive classes are denoted by the letters A, B, C, etc., A^1, B^1, etc., denote the short-time students who stay for 17 weeks only; A^2, B^2, etc., those staying for 26 weeks. The figures at the tops of the columns refer to the subjects in the preceding Conspectus of Studies. The 26 weeks here shown cover two periods and a half. At the beginning of the first period, class C is just starting, class B has completed most of its elementary studies and is starting on advanced work, and the long-time members of class A (A^2), are entering on their last 6 weeks, which are devoted to advanced operative and other special work, research work, or to volunteer service as instructors or assistants.

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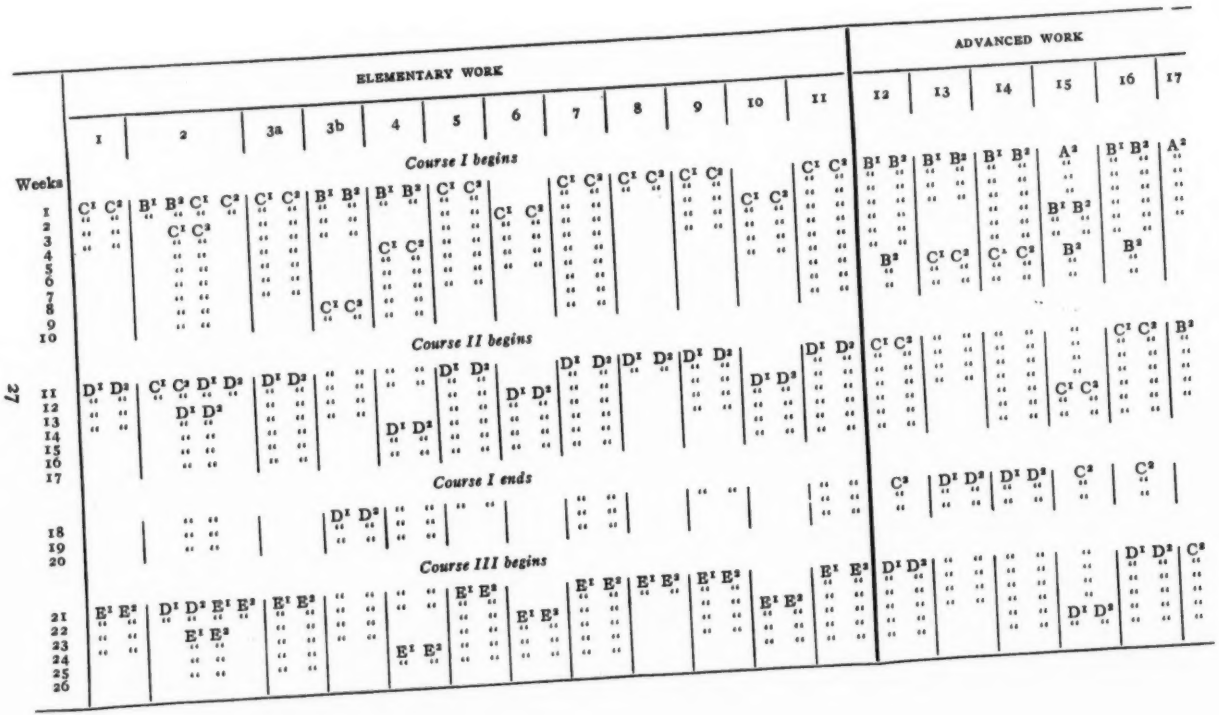
[1] For long-time students 15th and 26th week.

[2] For long-time students, 11th to 26th week.


ELEMENTARY WORK
ADVANCED WORK
1
2
3a
3b
4
5
6
7
8
9
10
11
12
13
14
15
16
17
Weeks
Course I begins
Course II begins
Course I ends
Course III begins

PLAN B

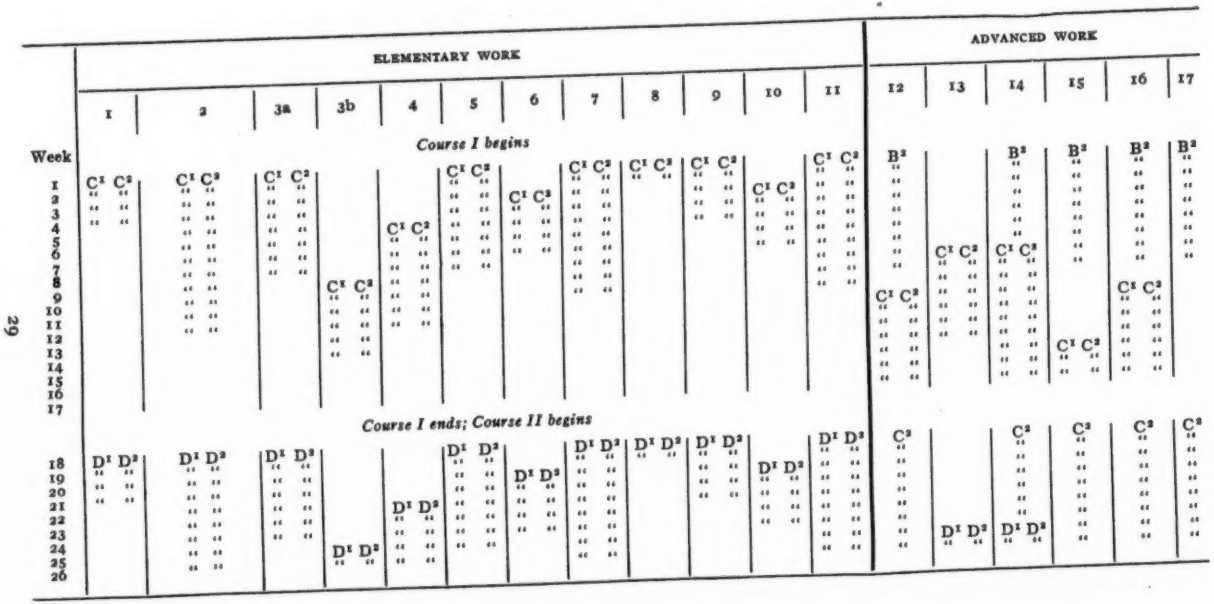
3 Terms of 17 weeks each. Consecutive.

Classes C^1 (short-time) and C^2 (long-time) students just beginning. Long-time students of previous section (B^2) just ending.

At 18th week new section (D^1 and D^2) begins.

I am well aware that a four months' course is not sufficient to give a man full training in ophthalmology. For example, the time here allotted for physiological optics, for laboratory practice and for operative work should properly be extended by several weeks, in each instance. Nevertheless, a man who pursues the course here outlined could gain a thorough training in the fundamentals of each subject, enabling him to continue further study with advantage as opportunity offered, and would be able to enter on ophthalmological practice with a well justified confidence that he could handle most cases with intelligent knowledge and reasonable skill.

For men who have already had some training and experience in eye work, the course outlined and particularly the half-year (long-time) course would be specially beneficial. It would extend and complete their knowledge and because of the drill in the fundamentals, would put it on a sound basis. After completing it, they will have learned to handle cases of all types methodically and according to an intelligent plan. Ordinary external diseases, errors of refraction and motor anomalies—the three conditions that will constitute the vast bulk of their practice—they should be able to manage without difficulty. And, what is perhaps equally important, they will have learned to recognize their limitations, and when they meet with a case that they cannot diagnosticate or handle, they will appreciate the fact and refer it to one more skillful. Lastly, they will be stimulated by the knowledge that they have gained and the appreciation of their deficiencies to further study and practice in order to render their education indeed complete.


ELEMENTARY WORK
ADVANCED WORK
1
2
3a
3b
4
5
6
7
8
9
10
11
12
13
14
15
16
17
Week
Course I begins
Course I ends; Course II begins

EPITHELIAL INLAY AND OUTLAY IN LID REPAIR ILLUSTRATED.[1]

By Colonel S. HANFORD McKEE, C.M.G., C.A.M.C.

Formerly, Officer Commanding, Westcliffe Canadian Eye & Ear Hospital.

(With nine illustrations on Text-Plates I.–III.)

EYE injuries in previous wars have formed only a small percentage of all wounds. While the proportion in the late war may not be much higher, Armageddon with its terrible face injuries has brought this subject very prominently before us. It has given us the opportunity for wonderful development in plastic surgery of the face and has forced upon us the necessity for studying the restoration of the orbit and eyelids, and repair of the conjunctival sac, so that an artificial eye may be worn.

It is not my purpose in this paper to cover the subject of plastic surgery of the eyelids in so far as pedunculated skin flap and transplantation of cartilage are concerned, but to take up for a few minutes what I expect most of the members are now well acquainted with, namely epidermic inlay, in its relation to the enlargement of the conjunctival sac, and secondly, epidermic outlay and its use in lid repair.

In the *Annals of Surgery* for March, 1917, Essen has given us his "Studies in Plastic Surgery of the Face" and has described there, in detail, his method for enlargement of the conjunctival sac.

The difficulty met with in enlarging this cul-de-sac, or rather in retaining an enlargement made, will be readily admitted by

[1] Read at the American Academy of Ophthalmology and Oto-Laryngology, October 17, 1919.

ILLUSTRATING DR. MCKEE'S ARTICLE ON "EPITHELIAL INLAY AND OUTLAY IN LID REPAIR ILLUSTRATED."

FIG. 1. Original condition.

FIG. 2. Excision of scar and repair.

FIG. 3. Note large epidermic inlay and how socket has been enlarged from Fig. 2.

FIG. 4. Large eye temporarily used to show extent of new formed cavity.

ILLUSTRATING DR. MCKEE'S ARTICLE ON "EPITHELIAL INLAY AND OUTLAY IN LID REPAIR ILLUSTRATED."

FIG. 5. Epidermic outlay.
R. lower lid.

FIG. 6. Epidermic outlay.
L. upper lid.

FIG. 7. Showing both eyes closed, ectropion repaired.

all. This difficulty has now been done away with and Esser, Gillies, Waldron, Risdon, and others have given us a method as satisfactory in results as it is simple in procedure. Esser enlarged the conjunctival sac by means of a buried skin graft. An incision was made through the eyelid skin parallel to the palpebral fissure and extended laterally according to the extent of the conjunctival deficiency. The tissues were then undercut as close to the conjunctival sac as possible without perforating into the same, and an impression of the cavity thus formed taken with dental compound sterilized by boiling. The mold was then pared until the margins of the incision could be brought together without undue tension.

A thin Thiersch graft was then taken from the inner surface of the upper arm and wrapped around the mold. The whole was then inserted into the cavity and the margins of the incision carefully sutured over it. In two weeks' time an incision was made through the conjunctiva overlying the mold, which was then removed, and the epithelialized area thus formed maintained by the immediate insertion of a temporary shell until an artificial eye could be fitted.

Waldron very materially modified and improved that technique by making the primary incision *in the conjunctival sac* instead of through the eyelid skin. The tissues were then undercut until a cavity somewhat larger than that desired was obtained. The dental compound was then made, covered by skin graft, buried, and held in place by suturing the cut margins of the conjunctiva.

Where it is found difficult to make an incision close to the tarsus and to do the necessary undercutting, an incision outwards and slightly downwards for 1*cm* from the external canthus is made. This permits easier eversion of the lid and renders the operative field more accessible.

Waldron claims for his modification: (1) Unnecessary scarring of the eyelids is prevented and the normal elasticity of the skin is not impaired. As it is not uncommon to have an accumulation of serum develop around the buried graft, sutures may give way, and slight infection may take place without impairing the success of the graft. These minor complications, however, in the case of inlays buried through an incision in the eyelid skin may lead to granulation and scarring, and in rare

instances epithelialized fistulæ have developed, necessitating operative excision and closure. (2) The exact position of the new fornix may be better outlined by an initial incision through the conjunctiva than by the undercutting to a point just beneath the surface of the conjunctiva. In our experience, the fornix may be made closer to the tarsal plate by incising through the conjunctiva. (3) The depth and direction of the cavity can be readily determined according to the necessity of the individual case.

After cutting the conjunctiva and removing the compound in a few cases, I felt the suturing in of the compound so that the conjunctiva had to be cut to release it was a mistake and a weak spot in the technique, and I soon began leaving a space at the top so that while the compound and graft were still held properly in place, the former could be removed without any cutting. Risdon has improved on this idea and keeps his graft over compound in place by the pressure of the lids alone. So, to enlarge the upper or lower conjunctival cul-de-sac, an incision is made above or below to the extent thought needed. Dental compound is molded and fitted and a Thiersch graft is then buried and held in place for one week or ten days by the upper and lower lids alone or drawn together by a suture. At the end of ten days the lids are separated, the compound removed, and an artificial eye inserted immediately.

Each case must be studied on its merits and where one variation may suit one case, it probably will not do at all in the next. Naturally the size, shape, and position of the mold vary considerably. Where there is a general contraction of the socket, I, at one period, thought putting the graft in the *mid-line* a good idea. This I now think a mistake and feel sure the enlargement should be made either below or above. This will give a much better *cul-de-sac* for a glass eye than the general enlargement from a centrally inserted inlay.

Pte. D. Admitted to Hospital with right eye enucleated, gonorrhœal ophthalmia—socket very shallow. An incision was made along whole floor of cavity and an inlay over compound inserted. Three days later the compound had suppurated out. The graft took completely.

Pte. McI. Admitted to Hospital G. S. W., left eye enucleated, the left lid so adherent, there was no cul-de-sac below.

ILLUSTRATING DR. MCKEE'S ARTICLE ON "EPITHELIAL INLAY AND OUTLAY IN LID REPAIR ILLUSTRATED."

FIG. 8. R. Large epidermic outlay above to lower right inner canthus.

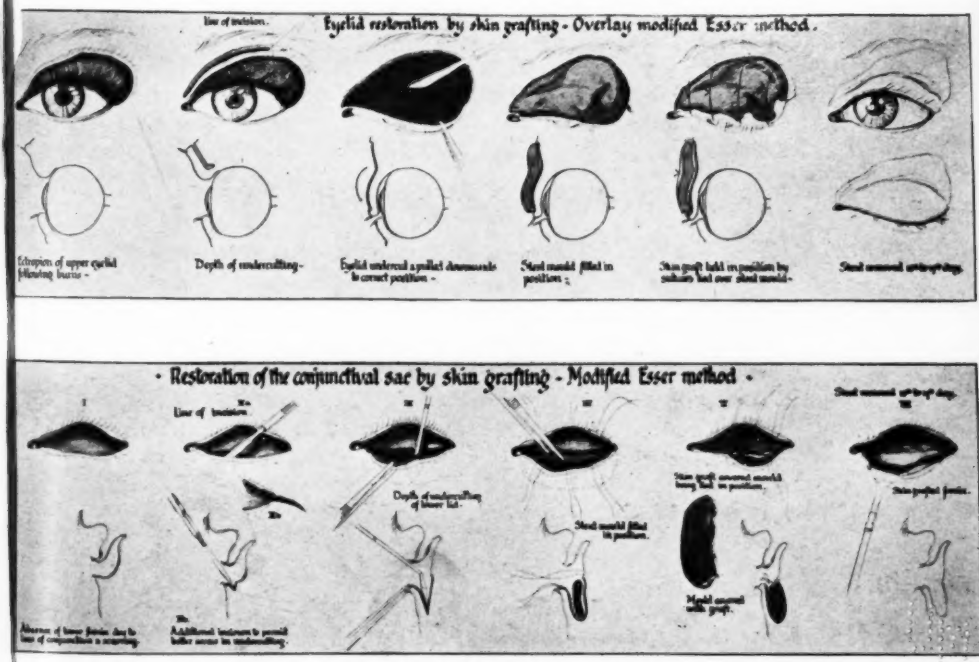

Eyelid restoration by skin grafting - Overlay modified Esser method.
Restoration of the conjunctival sac by skin grafting - Modified Esser method.

FIG. 9. Drawings made for Major C. W. Waldron, C.A.M.C., to demonstrate different steps in epidermic overlay and inlay.

Under ether a large inlay was put in below. Five days later the stitches broke away and the compound suppurated out. In spite of this the graft remained and became a most satisfactory result. These two cases are cited to emphasize a very important point, that suppuration will not destroy your result.

Gillies, of Queen's Hospital, has given us two modifications of the Esser process. In the first, called by him epithelial outlay, the mold covered with graft is buried in the subcutaneous tissues through an incision in the skin and is removed though the same incision. The cavity opened is covered with skin. It is really the converse of the inlay. In cases of severe ectropion from wounds or burns this method will be found most excellent. The eyelid skin may be increased to the extent of the grafted area. In burn cases the skin needs to be increased particularly in the vertical direction. The line of the incision and amount of undercutting varies of course with individual cases according to the degree of injury to be repaired. The incision is widened and deepened according to the amount of new tissue desired. Due care is taken to avoid injuring the levator palpebræ superioris.

After the dental compound is in position, the ectropion is, of course, more marked than before.

The second method of Gillies is termed epithelial overlay and is of great service where there has been extensive loss of tissue. Here extensive undercutting may be necessary, before the remains of the eyelid can be brought to its normal position, and the covering in of a graft-covered mold is impossible. In that case the remains of the eyelid may be sewn in a favorable position, the scars excised, and an impression taken of the entire raw area. A Thiersch graft is then applied to the raw area and held firmly in place by means of the compound impression. This method will often do away with the necessity for pedunculated flaps.

I hope my remarks have been sufficient to give you some idea of what can be done in the repair of lids by epidermic inlay and outlay.

It is essential that the cavity be made much larger than thought necessary. It will undoubtedly shrink some. Suppuration will not destroy your result. After the compound is

removed, put in an artificial eye as soon as possible This often has a beneficial effect on the hypersecretion sometimes present.

These methods are not a panacea, though they give results vastly superior to any previous ones, and offer much to ophthalmic surgeons. The results obtained in extensive ectropion following burns by the epidermic outlay technique of Gillies, are most satisfactory. Equally so are the results obtained by the epidermic inlay method of Waldron, in injured lids and in shallow and distorted conjunctival sacs. The development in military ophthalmology along these lines has been extensive indeed.

WAR INJURIES OF THE EYELIDS.

Plastic Operations for a Few Types. Case Reports with Photographs and Drawings.

By CAPTAIN JOHN M. WHEELER, M. C., U. S. A., Fort McHenry, Md.

(With thirteen illustrations on Text-Plates IV and V.)

AT Fort McHenry we have had a large and active service in plastic surgery about the eyes. Much of this has had to do with the lids. We have had large enough series of cases of different types so that we could study methods, and it is my desire to present a few suggestions in regard to the surgical handling of some of the types of lid injury.

1. *Notch of the Eyelid Associated with Laceration of the Tarsus.*—Illustrative of this type of injury, let me cite the history of a case.

McG. received a gunshot wound. Enucleation of the right eye had been performed in France. There was a marked disfigurement of the upper lid in the form of a notch. The tarsus was torn through completely, and imperfect union with scar tissue formation had taken place. A cicatricial band extended upward from the tarsal laceration in the lid substance, and a second band could be felt beneath the skin to the nasal side of the notch and independent of it, attached above to the orbital rim.

Fig. 1 illustrates the outward appearance of the deformity.

Operation.—The little mass of scar formation in the tarsus was excised, and the tarsal flaps were trimmed to give accurate apposition. Care was taken to excise fully as much tarsus at the upper margin as at the lower margin in each flap of tarsus. This is important, and even a slight overcorrection of the notch can be encouraged, at the surgeon's

discretion, by diverging the tarsal incisions from the lid margin, so as to make the tarsal flaps slightly shorter above than below. The skin and orbicularis were cut so as to make a flap as shown in Fig. 2.

The little tongue of skin was trimmed enough for adjustment, and above a small triangular piece of skin was removed, to save puckering. The conjunctiva and tarsal flaps were sutured as illustrated in Fig. 3. A mattress suture was carried through the flaps, as shown in Fig. 2, and tied after passing through a small rubber plate. Sutures were introduced to give good apposition of the skin flaps (Fig. 4). Dissection of the independent band of scar tissue was made through a separate skin incision (Fig. 4). The lids were then sewed together, so that the lower lid margin would act as a splint for the upper. Care was taken not to tie any of the sutures too tight and so cause sloughing. A rubber tissue dressing was applied. The sutures were all removed in four days.

An important point is that tarsal incisions and skin incisions should never be in the same position, but should be made in such a way that there is overlapping. Thus, what is known in carpentry as *halving* is accomplished, and union is assured, even if there is a little sloughing of the skin. Furthermore, recurrence of the notch formation is prevented.

In handling notch cases different short-cut procedures have been tried, but the "halving" method has been the only satisfactory one in my hands.

If necessary, to prevent tension on the wound, especially if the eyeball has not been removed, a canthotomy should be performed, and the branch of the external canthal ligament should be severed to release the tarsus. After healing there is no break in the continuity of the lid margin or in the row of eyelashes.

2. *Laceration of the Lower Lid from the Inner Canthus Downward and Outward.*—This type of deformity is seen in many cases of war injury, as well as in injuries of civil life, and the fact that failure to get proper healing with good results is the rule, and not the exception, is well known. Allow me to speak of an illustrative case and to mention a few points that make for success in the correction of the condition.

S. L. received a gunshot wound in action in the Argonne Forest, November 1, 1918. This resulted in rupture of the

ILLUSTRATING DR. WHEELER'S ARTICLE ON "WAR INJURIES OF THE EYELIDS."

FIG. 1. Case 1. Notch in upper eyelid due to laceration through the tarsus.

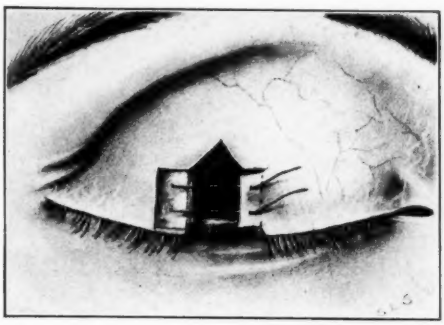


FIG. 2. Case 1. "Halving" operation. Dissection has been made. Mattress suture is shown passing through denuded tarsus on temporal side and flap of skin on nasal side.

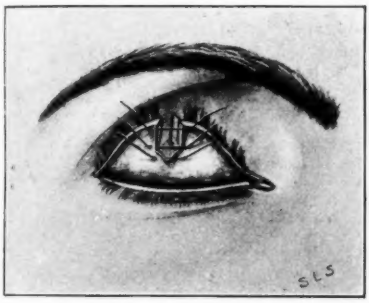


FIG. 3. Case 1. "Halving" operation. Lid everted. Conjunctival sutures ready to tie.

FIG. 4. Case 1. "Halving" operation. Sutures tied. Mattress suture passed through rubber plate. Upper and lower lids sutured together.

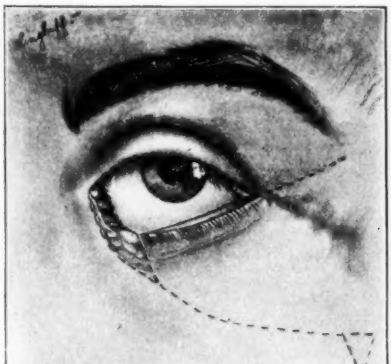


FIG. 5. Case 2. Laceration of the lower lid from the inner canthus downward and outward. Fracture of the superior maxilla and malar bones. Dotted lines indicate incisions.

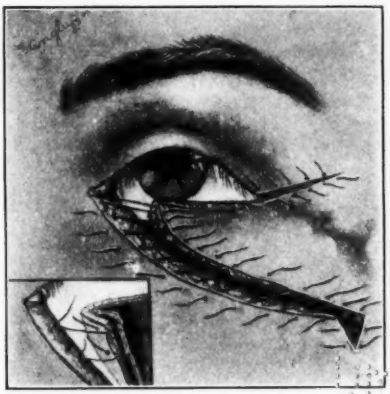


FIG. 6. Case 2. Dissection completed and sutures placed for advancement of lid flap, and repair of conditions shown in Fig. 5. Insert shows a splitting of flap to increase healing surface.

choroid (left eye), a laceration through the canaliculus of the left lower eyelid, and fracture of the left malar bone, with slightly depressed scars in the malar region. The coloboma of the lid is shown in Fig. 5. Two attempts had been made to correct the deformity. A mass of scar tissue was associated with the gap.

In this type of injury it is a difficult matter to get the apex of the lid flap to adhere accurately in position after operation. Usually it heals in a position too low, and usually fails to lie back in contact with the globe. For a good corrective result the apex of the lid flap should be fully up and back in position. Moreover, no new deformity should be added in the process of repair. In some of our cases that have had reparative procedures we have noticed deformity due to differences in the area of the two healing surfaces. In such cases the raw surface of the lid flap is liable to be more narrow than that of the nasal (stationary) flap. Furthermore, in some cases received at Fort McHenry, where there was incomplete adhesion of the two raw surfaces, it was evident that there had been no repair of the conjunctiva, which was concerned in the injury.

Fig. 5 is from a photograph before operation. No idea can be gained from the photograph of the amount of cicatricial tissue present at the site of the wound. Even on examination of the patient himself one is liable to underestimate the extent of subcutaneous scar tissue formation in such cases. ***This cicatricial tissue should be entirely removed***, even if the sacrifice seems great at the time of operation. There should be no compromise on this point, or failure may result from nonunion of the flaps or from breaking down of the tissue.

The incisions shown in Fig. 5 should be long enough to insure the possibility of sufficient advancement of the flap so that the end will fall into position without any tension whatever, after most of the sutures have been introduced.

Suturing.—Suturing should be started at the base of the movable flap and placed in such a way that the interspaces are greater in the stationary skin than in the movable lid flap. This difference in spacing should be greatest near the base of the flap, and should diminish toward the apex. In other words traction should be greatest at the base and should diminish

toward the apex of the lid flap, and at the end of the flap there should be none at all.

Anchorage.—Proper anchorage of the angle of the lid flap backward and upward in a position of slight overcorrection is important. This can be accomplished by carrying the skin sutures through more deeply in the tissues on the nasal side than in the lid flap, and by anchoring the apex back to the canthal ligament, carrying the angle of the lid flap as high as possible.

Drainage.—This is advisable in all plastic work of this kind. My preference is to avoid ligatures for bleeding vessels, and to rely on pressure and artery clamps to control hemorrhage during operation. In the tissues about the eyes, subcutaneous ligatures of any character are liable to cause trouble either early or late after operation. However, avoidance of ligatures on vessels leaves the possibility of the formation of a hæmatoma after operation, and this may become infected, and cause the wounds to open. A small gauze drain introduced at operation, and allowed to remain for a few days, is good preparation for such a possible mishap. The drain should be at or near the base of the flap.

Splitting the Margin of the Lid Flap.—In operating in this type of injury, the surgeon may be confronted with a discrepancy in the raw areas which must be brought in apposition. The margin of the lid flap is apt to be too narrow. It is important that apposing raw surfaces should match. A simple and effective scheme is to split the lid flap at its edge, as shown in the insert in Fig. 6, and thus increase its healing surface enough so that it will cover the apposing healing surface. The conjunctiva should be carefully sutured before the skin sutures are placed in the end of the flap. Fine silk thread should be used in the conjunctiva, and the sutures should be tied toward the eyeball.

Tension of Flaps.—Effective relaxation is important. Fig. 7 shows a good method. Strips of adhesive plaster are equipped with small hooks. Ordinary dress hooks, as suggested by Captain C. E. Nutter, are entirely satisfactory. Small perforations are made in the adhesive strips, and the hooks are slipped through; then the adhesive plaster is turned so as to inclose the base of the hooks, which cannot slip through the openings. The

adhesive strips are placed so that the proper traction will be produced to give relaxation of the flap. A rubber band is strung between the hooks to produce tension. Elasticity is essential to produce continuous traction, and I do not hesitate to recommend this method highly. The skin sutures should be removed in four days, to prevent the possibility of pus formation about them, and to prevent suture scars, but the relaxation apparatus should be kept on for ten days to two weeks, to assure strong union with the eyelid in the proper position.

Fig. 8 illustrates the photographic appearance three weeks after operation.

For suture material in this kind of plastic work linen thread dressed with paraffin and vaselin or with a beeswax preparation is most satisfactory. It is stout and pleasant to handle, and is not given to absorbing blood and serum to invite infection and pus formations.

In cases with injury to the lower canaliculus and impairment of lacrimal drainage, epiphora may be annoying, and removal of the main lobe of the lacrimal gland gives relief. In the case mentioned, and in similar cases, we have practiced extirpation of the gland with satisfactory results.

3. Laceration of Lower Lid Near Inner Canthus with Coloboma and Cicatricial Ectropion.—In order to bring out two more points in the repair of the type of case just mentioned under the second heading, I wish to speak of another case belonging to the same type.

> Private T. R. received a gunshot wound, causing a laceration through the lower canaliculus of the right eyelid, a marked ectropion, a large coloboma, and a heavy mat of scar tissue, overlying a fracture of the superior maxillary bone. Fig. 9 is from a photograph taken on the patient's admission to General Hospital No. 2 at Fort McHenry.
>
> The mass of scar tissue was excised, and several small foreign bodies were removed. I might say in this connection that in war wound cases foreign particles are almost always found in the dissection of scar tissue, and sequestra are occasionally encountered. A free canthotomy was performed, and an incision was carried upward and outward from the outer canthus.

Fig. 10 shows the lid flap that was shaped, the drain, and the skin sutures in place. What I want to emphasize here par-

ticularly is the advantage that was taken of the fact that a very small area of skin was left uninjured at the inner canthus. This was dissected up carefully and was preserved uninjured. Unless such cases as this have been subjected to operations, usually some such little flap of skin can be seen, and by delicate dissection lifted from its bed. In removing the scar tissue and the skin involved in the cicatrix, care was taken to save a little flap of tarsus. In suturing, this little tarsal flap was slipped behind the little skin flap, and held there by a mattress suture, tied so as to assure apposition of the raw surfaces, but not too tightly. Then the end of the tarsus was anchored upward and backward securely by a suture which passed through it and through the canthal ligament. It is safe to tie such a suture snugly. In the healing process in this case there was no slipping of flaps. One can afford to sacrifice healthy skin of the lid when it seems very scarce, in order to get such a little flap of tarsus to help in the "halving" process. I think too much stress cannot be given to this idea.

The other point which I should like to make here is in regard to the value of a beveled incision such as was used in part of the dissection in this case, and shown in Fig. 10. After all scar tissue had been dissected out, an incision was carried downward and outward, and a triangle was removed from the lower flap at the temporal end of this incision. Obviously, this was done to allow advancement of the lid-flap for adjustment. In making this deep downward and outward incision, it was carved in a slanting (beveled) fashion instead of directly backward at right angles to the skin surface. Two important things are accomplished by this maneuver. First, permanent depression of the scar is largely avoided. Second, a larger healing area is afforded the flaps.

Fig. 11 is a photograph taken about three weeks after operation to show the lower eyelid in place.

4. Coloboma at the Outer Canthus.—This is a less common war injury than those already spoken of.

Corporal F. G. was wounded by high explosive in action on September 21, 1918, at St. Mihiel. Fragments produced rupture of the left eye. Enucleation was performed. Fracture of the left malar bone resulted, with wounds of the soft parts in the malar region. On admission to General Hospi-

ILLUSTRATING DR. WHEELER'S ARTICLE ON "WAR INJURIES OF THE EYELIDS."

FIG. 7. Case 2. Elastic relaxation applied at completion of operation.

FIG. 8. Case 2. Three weeks after operation.

FIG. 9. Case 3. Laceration of lower lid near inner canthus with coloboma and cicatricial ectropion. Fracture of orbital margin.

FIG. 11. Case 3. Three weeks after operation.

FIG. 10. Case 3. Dissection. Sutures ready to tie. Note dissection at inner canthus, exposed nasal end of tarsus, and beveled incision.

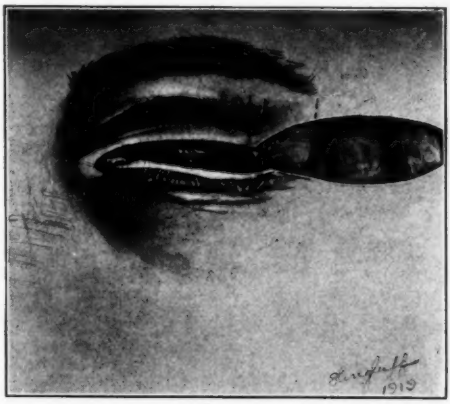


FIG. 12. Case 4. Coloboma at outer canthus, fracture and depressed scar. Dissection has been completed and subcutaneous grafts have been turned into depression.

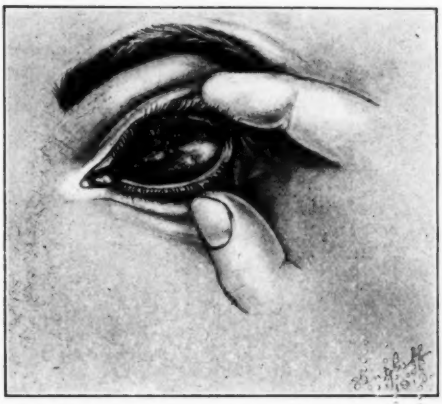


FIG. 13. Case 4. Cul-de-sac and outer canthus two and a half months after operation.

tal No. 2, Fort McHenry, the left eyelids were widely separated at the outer canthus. The outer part of the lower lid was everted, and a heavy depressed scar formation extended back one and one half inches from the outer end of the eyelids.

Operation.—Ether, March 22, 1919. The mass of scar tissue was largely excised, and the skin widely undermined in both upper and lower flaps. Subcutaneous grafts were everted on pedicles and sutured in position to fill in the depressed area. A subcutaneous graft was turned on the external orbital margin, and to this the conjunctiva was sewed. Another graft was turned over on the first, overlapping it in such a way that the nasal margin of the flap would shelve over the graft underneath. To the second graft the skin was sutured at the temporal ends of tarsi to make an outer canthus. In this way the cul-de-sac was made behind the newly formed canthus. The skin flaps in the malotemporal region were brought together by silk sutures. The handling of this case illustrates an important means of filling in depressions and reconstructing the outer canthus.

In this case there were three important objects to be attained. One was to fill in the unsightly depression behind the orbital margin. A second was to form a permanent cul-de-sac behind the outer canthal region. The third was to make a sightly outer canthus. In this case, to attain the first object, subcutaneous pedunculated grafts were used as filling. These grafts consisted of fascia, fat, and muscular tissue, and were cut so that their pedunculated bases were toward the depressed area, and with the attached bases as hinges were simply turned upside down into the depression and sutured in place (a single suture is enough for each flap). In order to get the proper adjustment of tissues for the formation of the canthus and the cul-de-sac which must reach behind the tissues at the canthus, care was taken in the placing of overlapping grafts, to the nasal margins of which first the conjunctiva and then the skin were anchored. In Fig. 12 an effort has been made to show the arrangement of the subcutaneous flaps and the manner in which the outer cul-de-sac and outer canthus were constructed.

In using subcutaneous grafts with pedicles it is important that the grafts should not be too large. It is better to use a series of small grafts than one large one, as there is much less

reaction following operation, less danger of their breaking down, and, most important of all, less deformity occasioned by operation. It is necessary to overcorrect slightly, in filling in depressions with subcutaneous grafts, as well as in the use of free grafts. Probably the depression in this case could have been filled in satisfactorily by the use of fascia lata, but free grafts would have made unsatisfactory anchors for the conjunctival and skin tissues at the outer canthus.

Fig. 12 shows the operative field after the mass of scar tissue had been removed, and the skin trimmed, and with the pedunculated grafts turned into the depressed area.

Fig. 13 illustrates the appearance of the outer canthus two and one half months after operation.

NOTES ON VERNAL CONJUNCTIVITIS[1]

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PERHAPS no better introduction to a discussion of vernal conjunctivitis can be found than the following paragraph from Axenfeld's (1) comprehensive report to the Société Française d'Ophtalmologie in March, 1907: "But the pathogenesis having remained obscure, the treatment largely inefficacious, the pathological anatomy disputed on important points it shall be our duty in this report to show what progress we have made in these latter years, which questions remain to be clarified, and how the researches of the future must be directed to lead us in the end to an interpretation of this disease which is one of the most distinctive and yet one of the most strange in the entire range of pathology."

These words serve well even to-day to define the attitude of ophthalmologists toward vernal conjunctivitis. Duane's edition (Fifth-American) of Fuchs's *Textbook of Ophthalmology* (2) reads as follows: "The prognosis is therefore good as regards the ultimate outcome, but bad as regards the duration, as up to the present time, we know of no remedy for curing the disease or for preventing its annual return. The cause of the disease is unknown."

Vernal "Conjunctivitis," as de Schweinitz (3) very properly insists it should be named instead of "Catarrh," though relatively rare is an unusually interesting clinical entity. Its literature has become quite extensive. Axenfeld (1) appended one hundred and thirty-five references to his report. That number could easily be increased now to more than two hundred. In this connection only a consideration of some salient

[1] Candidate's thesis, American Ophthalmological Society, 1919.

points of etiological, pathological, or therapeutic significance will be attempted with a few case reports outlining a simple and apparently efficacious method of treatment.

Etiological Factors—(A) Heat:

Haab (4) states that this disease is of special interest, because with the exception of miliaria, it is the only one affecting the human body, entirely dependent on "Heat" so that in cool summer seasons, it really does not develop. The persistent and regular return of the symptoms coincident with the advent of warm weather in spring or summer is the one fact upon which a diagnosis can be based with absolute assurance in connection with the clinical manifestations of this disease. While heat may be the immediate exciting factor it cannot be the sole cause. Only a small fraction of all eye patients have vernal conjunctivitis. The greatest frequency, reported by Trantas (5), (Constantinople) is about 1% of all patients, indicating that only a very small fraction of the general population are thus afflicted. Nearly all patients eventually attain to a recovery spontaneously after which the inexorable return of summer heat fails to develop the characteristic ocular symptoms. That the recurrence is determined by heat rather than by habit is evident from the experience of a young Argentinian observed by Morax (6) who for more than ten years had annual attacks at Buenos Ayres in November, December, and January. He came to Europe in October, 1904, and had no trouble until the following June when the disease returned with marked severity.

(B) Climate:

The influence of climate may be exerted on the conjunctival sac through dessication, wind, and dust, or by sunlight alone. Preponderance of evidence seems to justify the statement that where dry heat prevails vernal conjunctivitis is more prevalent than wherever the spring and summer seasons are associated with great humidity.

Bartels (7) stated that the rarity of vernal conjunctivitis in Lima and its frequent occurrence in southern Peru tends to confirm hot, dry, dusty, air as a cause. Herbert (8) saw thirty-nine cases in Bombay in two and a half years, but the discussion of his paper showed that the disease is rare in England where a relatively high degree of humidity prevails.

Jackson (9) reports forty-four cases collected in Denver during fifteen years, and adds that "ten years previous acquaintance with the disease in Philadelphia seems to indicate that it is more common in the dry elevated region of the Western United States." Feingold (10) states that "if unusual heat were to be the cause, New Orleans with its long summer should show a great deal of vernal conjunctivitis, but that it is characteristic of our city that no vernal conjunctivitis is seen or only in abortive cases." This apparent contradiction is in a large measure explained by the following additional statements (11) concerning the climate of New Orleans—"The precipitation exceeds sixty inches—New Orleans shows a maximum during June, July, August. The sky is clouded 50% of the winter season and 40% of the summer." Thus the great humidity and frequent relief from dusty winds by copious rainfall so modifies the usual effect of unchecked heat and dryness that Feingold's report is not unusual. Hosch (12) found that the conjunctivitis of springtime did not develop until summer if the former season were cool and moist and that prolonged rains in summer produced temporary relief. The reports of Saemisch, Schmeichler, Fuchs, Nils Remmen and Webster Fox are quoted by Axenfeld (1) as confirming the etiological importance of heat and drought. Danvers (13) reports on records of fifty cases of vernal conjunctivitis collected at Parma in his thesis for the Italian diploma of medicine. He seemed to find that humidity increased the frequency. In Italy the greatest rainfall occurs in fall and winter. The summers being so dry that the small river beds become dry and irrigation is often needed to ensure crops. It is hardly possible therefore to compare the occasional relative humidity during the dry summer season in Italy with other sections where the percentage of humidity is both high and constant. Given a dry and dust-laden atmosphere, it is to be expected that exposure to strong wind will increase their irritant effect on the conjunctiva. The more frequent and prolonged exposure out of doors may account for the greater frequency of vernal conjunctivitis among the rural population as noted by Weeks (14) and also by Danvers (13), thirty-three of whose fifty cases were from the country. Besides, in most cities more or less efficient methods are in use to lay the dust.

Bayer's experiments with transparent occlusive dressings seem to exclude any pathogenic effect of light, *per se.* Feingold (10) confirms this report by his own tests. Axenfeld presents the following tabulation reported by Widmark, Sweden, which tends to show that the prolonged illumination during summer in the higher latitudes is not an exciting cause.

	Latitude	*Hours Longest Day*	*(Fahrenheit) Average Temperature*	
			June	*Annual*
Haparanda (one case)	66	22½	53.0	32.5
Hernoesand (none in 10 years)	62	20	54.5	38.0
Gefle (one in 5000 —4 years)	60.5	18½	56.4	40.0
Stockholm (58—53402—14 yrs.)	59.5	17½	57.2	41.5
Lund (3 in 5600)	56	15½	61.5	45.0

(C) Microörganisms:

According to Weeks (14) and Kalt (15) a good argument may be made for the bacterial origin of vernal conjunctivitis. Axenfeld (1) finds no reason to affirm bacterial origin but says the possibility can not be denied without further research.

(D) Predisposition:

No matter what theory is advanced to explain vernal conjunctivitis, it is impossible to deny that individual susceptibility varies greatly even among those afflicted with the disease. Both general health and local conditions must be considered in this connection. Its spontaneous cure after an uncertain period and occasional relapses also indicate that the immunity is not constant.

The greater number of sufferers from vernal conjunctivitis belong to the male sex. Saemisch (18) reported that 79% of his 185 cases were males. Trantas (22) of Constantinople reports 90% males, and refers to the possibility that the greater frequency among Turkish men is due to their wearing of the fez which affords no protection for the eyes. Edward Jackson (9)

reports 57% males, and states that the preponderance might be easily accounted for by more general exposure to light and dust.

The disease usually begins between the 6th and 20th years of age, although exceptional cases are reported beginning earlier or later. Jackson saw one case beginning in a woman seventy-five years of age and recurring for three successive summers. The average duration is placed by Saemisch (18) at four to six years, but Gasparini (23) reports histological studies of an eye of a patient sixty-four years of age who had suffered from the disease for fifty-two years.

Race and consanguinity seem to be negligible factors so far as vernal conjunctivitis is concerned. Morax (6) Fuchs (24) report instances where two children of the same family were afflicted while other children showed no ocular disturbance at all. Angellucci (25) and Wechsler (26), each saw a child with vernal conjunctivitis where a parent had previously suffered from the same disease. An additional case is reported by the writer in this series.

Careful studies of the general health have failed to reveal any condition sufficiently constant to be directly associated with individual susceptibility. For example, Axenfeld (1) quoted reports of general lymphocytosis which coincided with his own investigations. His view was endorsed in subsequent discussions by Gallemaerts, Brussels (27), who had noted an increase of eosinophile lymphocytes, but was directly contrary to the results of tests reported by de Lapersonne (28), where the blood was found absolutely normal on repeated examination. More recently, Butler (29) reports a slight but constant eosinophilia.

The same incompatibility of evidence seems to pertain to anemia and other general nutritional changes. Botterri (30) states that all patients were strong peasants and showed marked pigmentation while Schleich (31) reports low nutrition and anemia constant. Von Michel (32) at one time insisted that the underlying malady must be one involving the entire system of lymphatic ganglia, therefore hereditary lues must be considered. Equally futile have been attempts to establish any relation between vernal conjunctivitis and general or local tuberculosis.

Boé (33) regrets that the disease is not serious enough to

permit studies on the effect of transfusion of blood between susceptible persons, etc. He refers to a case where an attack of puerperal fever suddenly and totally eliminated vernal conjunctivitis.

Local or general skin diseases, diseases of the nose, hay fever, or other types of conjunctivitis may be coexistent but have shown no constant etiological relation to vernal conjunctivitis.

(E) Location:

Vernal conjunctivitis is strictly a local disease. Its most typical alterations involve the conjunctiva on the tarsus or at the corneal limbus or both. General congestion of the ocular conjunctiva when present, is secondary to the intense itching and photophobia. Often the ocular congestion is localized about one or several points of the limbus in such a way that this disease was designated as "Phlyctæna pallida" by V. Graefe (34).

Some patients show changes at the limbus only giving rise to the name "Perikerato conjunctivitis exuberans" applied by Carmoney Valle (16), Mexico. In others the typical alterations in the tarsal conjunctiva predominate. Many show a combination of these but of variable severity. In some, even that very unique and almost constant objective clinical sign of the disease—the "bluish milky" surface reflex, is missing. Jackson (9) found it present in only seventeen of his forty-four cases. The diagnosis is then dependent on a regularly recurring rather localized and characteristic congestion of the ocular conjunctiva with itching and mild photophobia.

These variations seem not to be limited by locality or climate. Conclusions based on any one series may be misleading. Larger numbers and longer periods give more nearly uniform results. Ahlstroem (17) in a collection of ninety-six cases found 50% were of the palpebral, 24% of the ocular, and 26% of the mixed type. Saemisch (18) found the mixed type much more abundant than either the purely palpebral or bulbar varieties. Trantas (5) reported 75% of mixed type. Stark (19) stated that the palpebral type was not seen at El Paso, Texas. Recent reports by Gonzalez (20) and Fernandez (21) indicate that both bulbar and palpebral types are to be found in Mexico and Cuba.

Why is it thus localized? It is possible that some reason

may be found which might assist in a better understanding of the etiology. The significant fact that these are the portions of the conjunctival sac where the conjunctiva is *firmly attached to its base* has apparently not received the attention it deserves. The conjunctiva of the fornix and the ocular (bulbar) conjunctiva throughout—except at the limbus where its epithelium merges with that of the cornea, is freely movable over the underlying connective tissue, and is actually kept in motion—except during sleep—by incessant movements of the globe and lids. Such mobility means increased circulation, both in the blood-vessels and the lymphatics. This in turn means better local nutrition and the more efficient elimination of waste products.

According to Koeppe (35) the episcleral blood vessels are well supplied with lymphatics, even the finest capillaries being surrounded by relatively large spaces. These include the capillary loops at the limbus but contrary to the theory of Von Recklinghausen (36) they do not anastomose with the corneal lymph spaces. The flow of lymph therefore is probably somewhat sluggish at this fixed terminus of true conjunctival tissue which Morax (37) calls *une portion intercalaire*.

That the circulation of the scleral and ciliary vessels at the limbus is more vigorous at the limbus than that of the conjunctival vessels is indicated by the fact that in conjunctival inflammations the congestion at the limbus is usually less than at any other zone of the ocular conjunctiva while the reverse is true with ciliary congestion. The recent examination of the eyes of a soldier burned August, 1918, with mustard gas, showed that the cicatricial zone of 2 to 3 *mm* width, surrounding the cornea, was supplied by new vessels branching from the deep ciliary vessels at the limbus while the network of conjunctival vessels stopped at the outer margin of this zone at a sharp line of demarkation. Furthermore there would appear to be no chance for either blood or lymph to flow as freely in the tarsal conjunctiva, closely adherent to a firm fibrous base as in any other part of the conjunctival area.

The notable epithelial proliferations of vernal conjunctivitis occur at the limbus where the stratified columnar epithelium of the conjunctival sac has been converted into the stratified squamous type to merge with epithelial covering of the cornea.

The papillary hyperplasia of connective tissue with hyaline degeneration occurs in the palpebral conjunctiva covered by the usual stratified columnar epithelium which seems to be but slightly disturbed by the process. The narrow band of smooth squamous epithelium at the lid margin where it merges with the skin, apparently forms the boundary for the changes incident to vernal conjunctivitis as it does for trachoma (Ball, 38).

Normally, there is considerable evaporation from the conjunctival surface. The loss is supplied by moisture secreted by the mucous membrane and only after exceptional irritation are tears supplied by the lacrimal gland. In the presence of greater heat and dryness, especially if there is any failure in the conjunctival secretory function, the parts likely to suffer first are those where the subconjunctival circulation is least elastic, probably at the fixed points as above noted. Though the greatest direct loss is from the ocular surface the movement of the eyelids distributes this loss rather uniformly over the tarsal conjunctiva as well. Probably most of the moisture for the surface of the cornea is normally supplied by the conjunctiva on the superior tarsus.

The first effect would thus be exerted on the epithelium, but the subepithelial reaction would be almost simultaneous. The question of priority among these changes has caused much discussion. Vetsch (39), among the earliest to undertake histological study of the disease, concluded that the epithelial proliferation is the primary and most important pathological change in the tissue. Axenfeld (1) believes that the inflammatory reaction develops in the conjunctival connective tissue and that the epithelial proliferations are secondary changes. According to Schieck (40) tissue proliferation and hyaline degeneration play the principal rôle—not merely in the conjunctiva proper, but in the underlying tarsal or episcleral tissues. Cellular infiltration seems to be entirely secondary. Kalt (15) and Ginsberg (41) point out that opportunity to study early cases alone can answer this question.

Adams (42) notes that in vernal conjunctivitis "there is very slight mucoid change," while in trachoma and follicular conjunctivitis mucoid changes are extensive. This modification of epithelial function may bear some relation to the intense

itching through irritation of the nerve endings by the changed composition of the secretion.

As Chaillous (43) points out, itching probably precedes all other manifestations. In some cases, structural changes are so slight that only the ocular congestion and itching indicate the return of the disease with each spring or summer season. Perhaps the earliest structural change is drying of the superficial epithelial cells, provoking cell proliferation and extension downward as a natural reaction for protection against further drying. The most superficial cells may become homogeneous and lose their nuclear staining, thus simulating in appearance if not in actual change of substance, the Keratin lamellæ of the skin (Ginsberg, 41).

The special conjunctival nerve endings, Krause's corpuscles, differ from the Pacinian corpuscles of the skin by the absence of a thick laminated investment. They may be unusually sensitive to chemical irritants liberated by the effect of heat and dryness on the epithelium. The chemical changes incident to the loss of water, in the presence of sensitizing enzymes, may cause these cells to become the irritant factor provoking the tissue reactions which have been noted.

The itching and subsequent rubbing of the eyelids may inoculate these dried cells into the sensitized tissue producing locally the reaction of an anaphylatoxin. Leucopenia and eosinophilia are noted as general effects of anaphylactic toxin (Wells, 44). Such a local reaction might be assumed from the abundance of eosinophiles and the slight local lymphocytosis in vernal conjunctivitis as compared with trachoma, follicular catarrh, etc. The tissue reaction could be explained in this way without recourse to a specific bacterial infection. According to Pereyra (45) eosinophiles are present in various types of conjunctival inflammations and are constant in "provoked" conjunctivitis from drugs or superficial caustics.

If the itching were present only where hyaline deposits are found, chemical or mechanical irritation from that source might be to blame. On the other hand, the subjective discomfort ceases with cool or damp weather, but the hyaline deposits often show but little change between seasons. Hence it seems unlikely that they are concerned in producing these symptoms.

Practically at the same time, a subepithelial hyperplasia of connective tissue ensues. If this pushes upward between these epithelial invaginations, nodules are formed. These differ from the lymphoid granulations of trachoma by containing relatively few lymphocytes, but a marked predominance of connective tissue cells with more or less hyaline degeneration. The thin layer of hyaline degeneration may extend quite uniformly throughout the conjunctival sac (equals degenerative changes of the ground substance fibers and interfibrillary exudates), producing the "bluish milky" or opalescent reflex. Relatively few blood vessels are found in this new hyperplastic tissue and its products.

The presence of hyaline is so constant that it appears to be another phase of nature's defense against the irritant agent or organism producing this disease. According to H. G. Wells (45) "there is no one chemical compound 'hyaline' which accumulating in cells or tissues produces a hyaline appearance." He describes a form of hyaline observed in scar tissue which develops after the blood supply has been reduced to a minimum and states that presumably it is "similar in nature to the collagen of normal fibrous tissue intercellular substance which has undergone physical rather than chemical changes into a homogeneous hyaline substance. It has for its physiological prototype the thick 'collagenous' fibers of the subcutaneous connective tissue."

Axenfeld (46) suggests that the characteristic "bluish milky" reflex of vernal conjunctivitis is due chiefly to the subepithelial homogeneous sclerosis of proliferated connective tissue but states that epithelial thickening may have a part in it. According to Stoehr (47) the superficial cells of the stratified columnar epithelium normally show a thin hyaline cuticular seam.

If we attempt to generalize from these reports, it would appear that the deviations in the histological structures of the conjunctiva tend to approach the epidermal structure, both by the pseudo-keratinization of the epithelium, and by the formation of hyaline in subepithelial connective tissue. These changes do not occur where the vascular and lymphatic circulation is unusually abundant nor in the fornices where the drying out process is prevented primarily by the lack of exposure.

This analogy is masked through a number of secondary developments. Unusual large masses of epithelial proliferation with cystic degeneration (Antonelli, 48) at the limbus are reported. Large localized relapsing nodules of connective tissue develop in the tarsal conjunctiva which do not fit into this general picture of temporary epidermization of the conjunctiva in vernal conjunctivitis. However, once the provocation for connective tissue or epithelial proliferation having been supplied, it is not impossible for the special local developments which have been reported in connection with this disease to occur. A long standing relapsing process need not conform to the original typical defensive process incident to summer heat and dryness.

During the fall and winter season, the conjunctival tissues usually manifest a strong tendency to return to normal through absorption of necrotic tissues and through the regular development of connective tissue cells into normal fibrous structure. In the torrid zone according to Gonzalez (20) and Fernandez (21) the difference in temperature is so slight that the return to normal is practically never accomplished, though the acute symptoms disappear. Parsons (49) also reports that his observations indicate but little change due to change of season.

Therapeutic Measures:

A simple and certain method of securing relief from the annoying symptoms of vernal conjunctivitis noted by Axenfeld (1) was the occlusive dressing. As above noted, it was not found necessary to exclude both light and air. A transparent covering for the eyes was sufficient to obtain much relief, but the symptoms returned whenever the dressing was discontinued in warm weather. These limitations hardly make of it a practical or popular remedy.

A large number of reports in recent years indicate that if properly applied X-rays or radium will produce marked amelioration of the discomfort, prevent relapses, and apparently cure vernal conjunctivitis.

The experiences of Allport (50), Pusey (51), Butler (29), Shumway (52) are convincing on this point. Radium is more popular than X-rays. Sufficient experience has apparently been accumulated to permit an accurate estimate of the proper dosage of radium with entire freedom from harmful effects.

According to Wells (53), X-rays stimulate cell-growth when applied in small amounts, but larger amounts produce necrosis. Immature cells and cells in active division are more sensitive than adult cells. Radium shares with X-rays the power of causing tissue necrosis and produces general lymphocytosis after prolonged exposure. They both have marked effect on metabolism and radium seems to stimulate the action of most enzymes. The favorable effect of X-rays and radium may be explained probably by their effect on local metabolism rather than by any bactericidal power. According to McCallum (54) "Roentgen rays have little injurious effect upon bacteria, but the 'Alpha' and 'Beta' rays from radium kill them directly."

By checking the new growth and promoting absorption of hyperplastic tissue, and by increasing the lymphocytosis, X-rays or radium might be expected to exert a very favorable influence on the course of the disease. Their effect on the enzymes or local sensitizing substances may also be a factor in the good results reported from their judicious use in vernal conjunctivitis.

Personal Experience:

The writer has not used X-rays or radium for this disease. His experience during the last eight years with a more simple remedy in the nine cases coming under his care has been eminently satisfactory.

CASE I.—*1911, June 7th.* Alma S. Aged 10. Eyes inflamed each spring until fall for last five years. Typical vernal conjunctivitis—palpebral changes predominate. Simple eyewash with adrenalin $\frac{1}{10}\%$ daily for one week without effect. First application of $AgNo_3$ ($\frac{1}{8}\%$) followed by *fibrolysin* to everted eyelids brought marked relief within a few minutes. Complete cessation of all subjective irritation occurred within a few days. Treatments continued two or three times weekly until August and at longer intervals until October. There was *no* return of symptoms. Kept under observation and treatment repeated once a month during following winter and summer (*1912*), there being absolutely no recurrence. Monthly treatments during next summer, *1913*,—no recurrence. Treated once only in *April, 1914*, instructed to report if any recurrence—there was none. No recurrence during *1915*. In *1916*, April 10th, had acute catarrhal conjunctivitis—no resemblance to

vernal type—no itching—considerable secretion—recovered within one week using argyrol solution 20% twice daily.

CASE 2.—*1911.* Boy. Aged 10. At Eye Clinic, O'Fallon Dispensary, Washington University Medical School. Typical vernal conjunctivitis—positive relief from discomfort after use of *fibrolysin*—case disappeared.

CASE 3.—*1912, July 12th.* Virginia G. Aged 8. Residence Central, Texas. Typical vernal conjunctivitis palpebral changes, causing diagnosis of trachoma by general practitioner at home with painful and ineffective treatment. Recurrent attacks in spring and summer for four years—intense itching and considerable photophobia. Use of $AgNo_3$ (⅛%) and *fibrolysin* followed by immediate relief. Applications repeated daily for ten days, when patient returned to Texas. Prescribed *fibrolysin* every two days and a mild zinc solution for daily use—remained comfortable rest of season (report by letter).

1913, May 20th.—Mother reports by letter, "Can't come to St. Louis until August." Advised use of *fibrolysin* every other day and zinc wash as before. Reports in person *August 1, 1913.* No nodules in palpebral or ocular conjunctiva—very thin opalescent film remains on conjunctiva, but subjectively *very* comfortable. Reports by letter *Feb. 19, 1916*—Doing well enough to require no treatment since *1913.*

CASE 4.—*1913, May 16th.* Ruth Z. Aged 26. Residence, Warren Co., Missouri. Eyes inflamed each year during hot weather as long as she can remember. Worse last two weeks "on account of housecleaning." Slight proliferation at limbus of right eye. Palpebral conjunctiva shows no sign of vernal conjunctivitis. Used $AgNo_3$ (⅛%) and *fibrolysin,* right and left. Prescribed zinc sozoiodolate solution (⅛%) twice daily.

June 5th.—Returns. Proliferations *now* typical of vernal conjunctivitis at limbus, right eye—tarsal conjunctiva beginning to be involved right and left. Rendered subjectively comfortable after use of $AgNo_3$ (⅛%) followed by *fibrolysin.* Prescribed *fibrolysin* to be dropped on everted eyelids right and left once daily, *stopping* zinc solution.

July 3d.—Doing well until "hot spell' a few days ago. Palpebral conjunctiva *now* shows typical nodules of vernal conjunctivitis. Remained five days for daily treatments. Use of $AgNo_3$ (⅛%) and *fibrolysin* followed by subjective comfort except late at night. Directed to resume zinc sozoiodolate solution (½%) night and morning and continue

use of *fibrolysin* every two days. Remained comfortable for remainder of *1913*.

1914.—No recurrence—no treatment.

1915.—No recurrence except slight discomfort at San Francisco Exposition. No treatment.

1916, July 17th. Returns. Inflammatory symptoms began last month, during intense hot spell. Smear shows eosinophile cells. Used $AgNo_3$ (⅛%) and *fibrolysin*. Itching stopped immediately after first treatments and did not recur. Returned home—directed to resume former home treatment. Promised to report any future recurrence. No report to date.

CASE 5.—*1915, June 12th.* John E. Aged 11. Typical vernal conjunctivitis began six weeks ago—marked thickening at limbus right and left. Severe burning and itching. Used holocain solution (1%), $AgNo_3$ (⅛%), and *fibrolysin*. Subjectively entirely comfortable after first treatment and eyes appear better on inspection. Treatments repeated every two days until June 24th when he ceased to report for treatment, because he was doing entirely well. *1916, Feb. 20th.* Father reports by request—states boy had no further trouble and promises to report if he has.

CASE 6.—*1915, June 15th.* Physician. Aged 39. Conjunctival congestion simulating phlyctenulæ at limbus one or both eyes, recurring regularly in spring and summer. No palpebral signs, no opalescent film. Initial attack twenty years ago nearly coincident with first attack of malaria which has since shown decided chronicity but no relation between attacks. Discomfort begins as early as April, if weather is dry and dusty, but more noticeable June and July. Cloudy weather and rain invariably brings some relief. Loss of sleep and travel seems to aggravate symptoms. Bathing eyes with either hot or cold water increases comfort. Wearing correction for astigmatism (+ 0.75 d. Cyl. Ax. Vertl.) increases comfort. Euphos, Amber, or Crooke's glass seemed to possess little advantage over plain glass for this purpose. Discomfort always less in morning but often worse during hot evening than during day. *Fibrolysin* used once on above date, arrested the attack for the summer *1915*—the latter part of which was spent in Colorado. No recurrence *1916* and *1917*—slight discomfort *1918*, and a slight recurrence in *April, 1919*—during an early warm spell. Being familiar with the rather harmless nature of these attacks and having very little discomfort during the last two attacks, he is watching for further developments before repeating the treatment.

CASE 7.—*1916, April 20th.* Frances D. Aged 53. Recurrent attacks of vernal conjunctivitis for 8 or 9 years characterized by itching, photophobia, and congestion of ocular conjunctiva. Tarsal conjunctiva smooth but shows opalescent film—no changes at limbus. Used holocain solution (1%), $AgNo_3$ (1/5%), and *fibrolysin* both eyes.

Following day. *No* photophobia nor congestion. Treatment repeated.

Three days later. Conjunctival irritation recurred after long automobile trip. Treatment same and directed use of zinc sozoiodolate solution (1/5%) at home night and morning.

Ten days later. Slight discomfort in right eye—used $AgNo_3$ (1/5%) and *fibrolysin* in right eye *only*.

Under observation for fifteen days longer for measurements of refraction but no further treatment used as discomfort had not returned.

Will report at once if it does.

1917, March 19th.—Slight return of symptoms of vernal conjunctivitis—used $AgNo_3$ (1/5%) and *fibrolysin*.

Three days later—very little itching, but some sensation of dryness since last treatment which was repeated.

Three weeks later—some itching after strong wind two days ago. Otherwise comfortable. Repeated treatment five times during next ten days, after which no further discomfort. Last seen in *January, 1918*, for readjustment of correction.

1919, May 12th.—Reports slight attack of ocular inflammation for a few days in April, 1918,—more severe attack this year (1919), lasting nearly a month. Some treatment by neighboring physician.

CASE 8.—*1916, Sept. 8th.* Geneva W. Aged 19. Eyes inflamed for two months. Much itching—worse at latter part of day. Similar attack during summer, *1915*. Eyelids show opalescent reflex of vernal conjunctivitis. Used Holocain solution (1%) $AgNo_3$ (1/5%) and *fibrolysin* on tarsal conjunctiva. Much better following day—treatment repeated.

Two days later—entirely comfortable—treatment repeated.

Three days later—slight discomfort—treatment repeated. Entirely comfortable through remainder of season.

1919, May 11th.—Her mother answers that patient had some conjunctival irritation during summer *1918*, but "not nearly so bad as before" and no recurrence during 1917—no treatment used since *September, 1916*.

CASE 9.—*January 29, 1919.* Lela I. Aged 9. Residence, Herculaneum, Mo.—Eyes inflamed in warm weather

for last three years. Usually begins about April but itching and ocular congestion with photophobia began several days ago during this unusual spell of warm weather in mid-winter. Typical opalescent film over tarsal conjunctiva both eyes with tiny nodules at limbus. Mother had similar attacks which began when she was about eighteen years of age. They recurred each summer for five years and then ceased spontaneously. Examination of mother's eyes reveals rather suggestive very thin milky film on palpebral conjunctiva though she had had no discomfort for ten years. Both the mother and the present patient are pronounced blondes.

Used Holocain solution (1%) and $AgNo_3$ (1/5%) followed by *fibrolysin*. Returns three days later reporting immediate improvement in comfort and less congestion. The mother did not conceal her surprise as all previous treatments during her own experience with the disease some years ago and for the last three years with her daughter had not been satisfactory. *Returns five weeks later.*—Eyes remained clear for some days, then some congestion at temporal limbus right eye. Palpebral conjunctiva remains smooth but shows pale opalescent film. Slight congestion at limbus on temporal side in each eye. Treatment repeated and directed to use zinc sozoiodolate solution (1/5%) twice daily at home.

1919, May 11th.—Mother reports child's eyes remained perfectly clear for two weeks after last visit and that symptoms now are so much milder that she did not wish to take her out of school to come to St. Louis for treatment.

This series of cases is too small to permit generalizations but the experience had been so satisfactory that it was mentioned privately to several ophthalmologists attending the meeting of the Colorado Ophthalmological Society in August, 1915. At least one, Dr. Robert Scott Lamb, had the hardihood to make use of *fibrolysin* in his own practice. He reports by letter as follows: "My first attempt was the corraling of *six* chronic recurrent typical and well-marked cases, well-known to have resisted all usual methods, put them in the hospital, under control, and use each night at bedtime, one drop of fibrolysin in each eye. Imagine my astonishment to find, at the end of ten days *all were well.* They were discharged from the hospital and requested to report to the out-patient department for observation once a week. There was no more vernal catarrh among them that season."

Dr. John Green, Jr., has kindly furnished the following case report:

> Girl. Aged 12, came under observation June 20, 1917.
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> *Ocular history.*—For the past three summers her eyes have been inflamed with itching and photophobia. The condition clears up in the autumn. She has never missed a day of school on account of her eyes. Two years ago Dr. Brose of Evansville, Ind., removed tonsils and adenoids and gave eye-drops. Home doctor used "blue stone." The patient presented a well-marked case of vernal conjunctivitis of the palpebral type.
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> Refraction:
>
> R + 1. sph. Vision $\frac{6}{4}$
> L + .75 sph. " $\frac{6}{4}$
>
> Euphos glasses gave some relief from the photophobia. After a few days treatment with a boric acid, cocaine nitrate and adrenalin mixture, fibrolysin was started and used every third day for three weeks. During this period, the patient was comfortable, the eyes opened more widely, and there was marked flattening of the palpebral plaques."

Of interest in this connection is the report of W. A. Sedwick (55) that in his first case presented to the Colorado Ophthalmological Society in August, 1917, the lids afterward became entirely smooth under local applications of *fibrolysin.*

Fibrolysin[1] was used in the first case as above noted, be-

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[1] "Fibrolysin—CS (NH_2) NHO_3H_5 ½ (C_6H_6—OH—COONa) Aqua. In order to avoid the pain caused by the subcutaneous injection of the alcoholic solution of thiosinamin (allyl-sulfo-urea), an aqueous solution of this compound has been prepared by F. Mendel. This was accomplished by combining one molecule of thiosinamin with one-half molecule of sodium salicylate. The resulting double salt forms a white crystalline powder which is readily soluble in cold water. The aqueous solutions are not stable to the action of light and air, hence are furnished in sterilized, sealed tubes containing 2.3*cc* of a solution, 1.5 parts of fibrolysin in 8.5 parts of water. Each tube represents 0.2*gm.* of thiosinamin. This is employed for resolving lupus grandular tumors, scleroderma, etc. (E. Merck.) Thiosinamin—CS, NH_2, NH, C_3H_5—a compound of ammonia and mustard oil, forming crystals of faint garlic odor, slightly soluble in water, readily in alcohol, fusing at 74°."

(Extract from *The Newer Remedies* by Virgil Coblentz, A.M., Phar.M., Ph.D., F.C.S., 4th edition—1908.)

cause it was believed that the absorption of the hyaline deposits might be accelerated and that an active lymphocutosis might modify favorably the course of vernal conjunctivitis. Clinical and experimental tests had shown that *fibrolysin* produced local lymphocytosis and promoted the absorption and softening of scar tissue. It had been used locally on the cornea and conjunctiva without injury. In fact, its use seemed to improve the resistance of corneal tissue, to aid materially in the cure of old indolent ulcers and in checking the progress of acute superficial corneal infections of every type.

The regular and persistent use of the remedy in the first case was possible because the patient, who had suffered much previously, was able and willing to report as directed. She apparently attained a complete cure.

Some of the other cases could not be followed up but the relief experienced by each while under observation was beyond question. In some of the later cases, *fibrolysin* was used as sparingly as possibly both because it was desired to measure the maximum effect of a minimum dosage and because, under war conditions, the preparation disappeared from the drug market, so that the small supply on hand was frugally conserved.

If one may hazard any conclusions as to the best therapeutic method from observations in such a limited number of cases, it would appear to be desirable not to depend on *fibrolysin* alone but to retain the use of silver or zinc salts in weak solutions for their beneficial effect on the epithelium. *Fibrolysin* seems to effect principally the subepithelial tissues. The use of Holocain solution (1%) just before using the *fibrolysin* proved to be desirable to shorten the period of burning usually accompanying the instillations of the latter solution.

For ocular treatments one or two drops of the solution of Fibrolysin as furnished in the sealed ampules without further dilution were dropped on the everted upper eyelids or directly on the cornea according to the effect desired. Rarely it was applied directly to the inflamed foci with cotton-tipped applicators. Treatments were repeated daily or at longer intervals according to results noted.

While the solution for hypodermic injections should not be exposed to light and air, no difficulty was experienced in keep-

ing the same for ocular treatments in a well-stoppered amber vial for several months without apparent loss of efficiency or the development of noxious qualities.

Apparently two or three applications a week are sufficient to produce and maintain freedom from the discomfort even in severe cases and during the hottest weather. It seems that treatment at intervals of one month throughout the year can prevent relapses and bring about a cure in some cases. That effort is certainly worth while in the absence of all harmful effects when the remedy is thus used.

The report of these cases seems to be fully justified by the disappointments of the past in the treatment of vernal conjunctivitis. The use of *fibrolysin* should not mean the neglect of any measure calculated to promote the well-being of the patient, such as correction of eyestrain and reasonable protection from exposure and proper attention to the general health.

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ROUTINE OFFICE MEASUREMENT OF STEREOPSIS.

By DAVID W. WELLS, M.D., F. A. C. S., Boston.

(With one illustration on Text-Plate VI. and one illustration in text.)

THE ocular estimation of the relative distance of two objects is the result of several psychic processes, some of which are possible to a person possessing but one eye. Of these, visibility, apparent size of objects known to be alike, and monocular parallax are the most important. The relative value of these different factors has been well stated by Eaton (*Brit. Journ. Ophthal.*, vol. iii., 1919). But Howard (*Trans. Am. Ophthal. Soc.*, 1919) has shown that while monocular judgments are valuable, the binocular parallactic angle is absolutely essential to any refinement of the faculty. The importance of this possession to the aviator he has demonstrated incontrovertibly. Just how valuable it is to the chauffeurs, engineers, and street-car motormen has never been critically determined.

When the facts are known it is quite possible that visual tests will not stop with measuring the acuity of each eye and color sense, but that a certain standard of stereopsis will be required.

In 1899, Pulfrich (Zeiss) introduced stereoscopic instruments for measuring distance. In using these it was found that some did not possess the requisite stereoscopic ability, so that it was necessary to select the observers. As a result of his experiments, he announced that persons with normal eyes have a power of perception of depth of 10″.

In 1908, James published in the *Lancet* a description of an instrument which he called a distance stereoscope for measuring the angle of binocular parallax. He stated that he found it to correspond with the angle of visual acuity; that is, if each eye possessed an acuity of 1′ the angle of binocular parallax was 1′, although he furnished no data of his experiments.

In 1919, Howard adopted a slight modification of the James apparatus and made exhaustive tests of aviators at the Medical Research Laboratory at Mineola. His experiments showed that an individual with normal eyes of equal acuity and orthophoria should be able to distinguish a depth difference of 1.5*cm* at 6*m*. This is equivalent to a parallactic angle of 10.2″ for a pupillary distance of 60*mm*. He was dealing with picked men, many of whom had an abnormal visual acuity, and with such the depth difference perception was wonderfully acute.

Howard has also experimented with semaphores of 13*cm* diameter at a distance of 100*m*. This size was adopted as it represents the tangent of the visual angle of 1′ at 100*m*. He examined a number of the same men whom he had tested at 6*m* and found the binocular parallactic angle practically the same. The office test at 6*m* is therefore a trustworthy measurement of field stereopsis. It had heretofore been assumed by the writer that with his graded perspective charts (Series E) and an ordinary stereoscope, it was quite easy to determine the stereoscopic acuity, but the 6*m* test certainly allows of a more exact grading of the faculty.

So far as known, our knowledge of the binocular parallactic angle is limited to the findings of these three observers. It would therefore seem desirable to secure the coöperation of a large number of ophthalmologists to make these tests and publish their results. To do this the first essential is an inexpensive workable apparatus, and the second is the adoption of certain standards so that the results may be comparable.

James and Howard used a box in which rods of 1*cm* diameter could be moved antero-posteriorly, noting the smallest difference in distance which the subject could recognize. James used white rods in a black box and Howard black rods in a white box. The tests were made at a distance of 6*m*.

Both speak of the importance of securing equal and uniform illumination. The apparatus of Cohen (*Archives Ophthal.*, March, 1919) overcomes this objection, and would be quite inexpensive if there were sufficient demand to make them in quantity. Dr. Cohen very kindly loaned his apparatus to the writer, giving permission to make such changes as were found desirable. Figure 1 shows it so modified.

It consists of a sheet iron cylinder 30*cm* diameter and 40*cm*

long, open at one end, mounted on a tripod. Originally it had four lights arranged quadrilaterally, but this has been simplified by reducing the number to two, in horizontal plane. The miniature lamps are on the ends of tubes which pierce the back of the cylinder and have an antero-posterior adjustment of about 20*cm.* The lights are covered with a white translucent glass and show evenly luminous circles of 28*mm* diameter. These were so arranged, that block letters or colored glass might be used in front of them. As now used, they are covered with black plates having openings of 1*cm.* One is fixed and the other plate is adjustable horizontally so as to make the separation equal to the subject's P. D. The whole affair is dead black, so that the observer sees only the two luminous disks. There is thus no possibility of utilizing any monocular parallax.

James says that the posterior stick should be .5*mm* larger than the anterior so that both would subtend the same visual angle, as otherwise the size of the retinal image might influence the judgment of the distance.

In order to make this difference exactly correct for varying distances, one of the lights was covered with an iris diaphragm, but in figuring out what this allowance should be, it was found that for a depth difference of 20*mm* the tangents of the visual angle vary only .03*mm*, for 200*mm*, .3*mm*. As the normal depth difference is 15 to 20*mm* it was evident that the size of the retinal image would not be appreciably influenced. The iris diaphragm was therefore discarded and two lights are of same diameter, 1*cm*. The ends of the tubes which project behind the cylinder are marked off in 5*mm* divisions.

The standard conditions suggested are as follows:

1. The apparatus shall be placed at 6*m* from observer.
2. The luminous disks shall be 1*cm* diameter.
3. Separation of disks equal to subject's P. D.

If these conditions are followed the results will be comparable with the experiments of James and Howard.

In using the instrument, the subject is asked to close his eyes and the depth difference arranged at 40 or 50*mm*. If on opening the eyes this difference is quickly recognized, the process is repeated with a smaller difference until the subject makes a mistake or is unable to see any difference. A few trials will suffice to determine a difference which is correctly

ILLUSTRATING DR. WELLS'S ARTICLE ON "ROUTINE OFFICE MEASUREMENT OF STEREOPSIS."

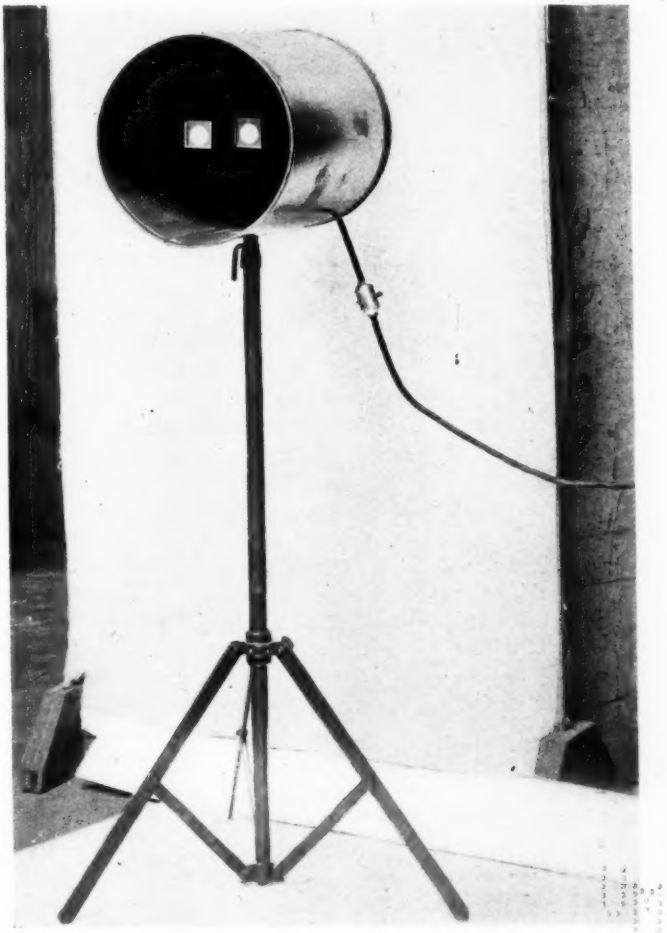


FIG. 1.

stated. Howard made twenty trials and considered that when answers were 75% correct, the subject's threshold had been determined. This seems to the writer a very unnecessary refinement, as a few trials suffice.

No one ever records visual acuity in terms of the visual angle, but as $\frac{1}{10}$ or 1. It is therefore evident that the record of ***depth difference*** at 6*m* will satisfy most of us. If, however, one wishes to know the parallactic angle it can be quickly determined by reference to the table which is abstracted from Howard's very elaborate figures. One decimal place is certainly sufficiently exact.

There are several methods of determining the angle for varying depth differences. The following figure is copied from James, the only change being the describing of an arc. This facilitates a simpler demonstration than that of James as follows:

Let A and B = the two luminous disks separated horizontally 60*mm* = to that of the nodal points L and R

Let AL = 6*m* = 6000*mm*

BR = 6180*mm;* that is B is 180*mm* farther from the observer than A

The right eye sees the two objects under the visual angle ARB

The left eye sees the two objects under the angle ALB

Draw AC parallel to LR

Then the triangle ALR = triangle CLR and parallactic angle = BLR − CLR = BLC

Since in right triangles tangent of an angle is the ratio of opposite side to adjacent side

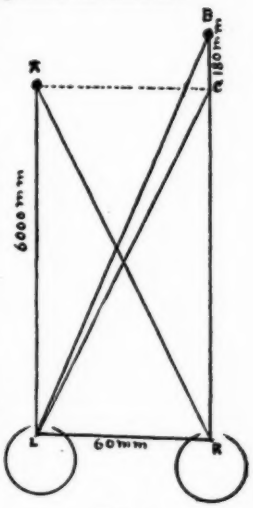


FIG. 2.

$$\text{Tang. BLR} = \frac{BR}{LR} = \frac{6180}{60} = 103 = \text{tang. of } 89^\circ\ 26'\ 40'' \text{ approximately}$$

$$\text{Tang. CLR} = \frac{CR}{LR} = \frac{6000}{60} = 100 = \text{tang. of } 89^\circ\ 25'\ 37'' \quad \text{“}$$

Therefore angle BLR − angle CLR = 89° 26′ 40″ − 89° 25′ 37″ = 1′ 3″ = parallactic angle, approximately.

ANTERO-POSTERIOR SEPARATION OF OBJECTS IN MM.

Pupillary Distance	5	10	15	20	25	30	40	50	60	90	120	150	180	210	240
58	1.6″	3.3″	4.9″	6.6″	8.2″	9.9″	13.2″	16.4″	19.7″	29.4″	39.0″	48.6″	58.0″	67.4″	76.6″
59	1.6″	3.3″	5.0″	6.7″	8.4″	10.0″	13.4″	16.7″	20.0″	29.9″	39.7″	49.4″	59.0″	68.5″	78.0′
60	1.7″	3.4″	5.1″	6.9″	8.6″	10.3″	13.7″	17.1″	20.5″	30.7″	40.7″	50.7″	60.5″	70.3″	79.9″
61	1.7″	3.4″	5.2″	6.9″	8.7″	10.4″	13.8″	17.3″	20.7″	30.9″	41.1″	51.1″	61.0″	70.9″	80.6″
62	1.7″	3.5″	5.3″	7.0″	8.8″	10.6″	14.1″	17.6″	21.1″	31.4″	41.7″	51.9″	62.0″	72.0″	81.9″
63	1.8″	3.6″	5.4″	7.1″	8.9″	10.7″	14.3″	17.8″	21.4″	32.0″	42.4″	52.8″	63.0″	73.2″	83.2″
64	1.8″	3.6″	5.4″	7.3″	9.1″	10.9″	14.5″	18.1″	21.7″	32.5″	43.1″	53.6″	64.0″	74.3″	84.6″
65	1.8″	3.7″	5.5″	7.4″	9.2″	11.1″	14.8″	18.4″	22.1″	33.0″	43.8″	54.4″	65.0″	75.5″	85.9″
66	1.8″	3.7″	5.6″	7.5″	9.4″	11.2″	15.0″	18.7″	22.4″	33.5″	44.4″	55.3″	66.0″	76.7″	87.2″
67	1.9″	3.8″	5.7″	7.6″	9.5″	11.4″	15.2″	19.0″	22.8″	34.0″	45.1″	56.1″	67.0″	77.8″	88.5″
68	1.9″	3.8″	5.8″	7.7″	9.6″	11.6″	15.4″	19.3″	23.1″	34.5″	45.8″	57.0″	68.0″	79.0″	89.8″

Table of B inocular Parallactic Angle.
Nearer object 6*m*
Size of object 1*cm*
Separation of object = P. D.

Howard's demonstration and tables which came to hand later, have been worked out by using the radian as a unit of measure and are evidence of a tremendous amount of patience. He determined his values to five significant figures, which is certainly a needless refinement and probably beyond the limits of accuracy of the experiment.

In presenting this very simple method of measuring stereopsis it is hoped that a number of ophthalmologists will coöperate by making it a part of the routine examination and publishing their results in terms of depth difference. Five minutes ought to suffice, and perhaps one minute more for recording the corresponding binocular parallactic angle. It ought certainly to claim the attention of those of us who are interested in stereoscopic fusion training, as James says he has found the apparatus of much value for this purpose. The writer is deeply indebted to Captain Howard for free use of his unpublished manuscripts.

THE MOTOR MUSCLES OF THE EYE

THEIR PATHOLOGY IN ASTHENOPIA

By E. H. HAZEN, M.D.

(Emeritus Professor of Ophthalmology and Clinical Ophthalmology, Drake University, Des Moines, Iowa.)

(*With one illustration on Text-Plate VII.*)

THE purpose of this article is to demonstrate the fact that the writer in treating the muscles for asthenopia has, unconsciously, discovered the pathological causes of asthenopia in the extrinsic muscles, and probably also in the ciliary. The course which has been taken, and arguments for the conclusions at which he has arrived, are here described.

It is now over fifty years since Professor Donders published his work *Anomalies of Accommodation and Refraction of the Eye*, which time covers, just about, the term of the writer's practice of ophthalmology.

Donders revolutionized ophthalmology. It was so great a boon to the world, and so filled a great gap in the practice, that even to-day there are but few who have advanced beyond his principles. His 'ology of asthenopia encompassed all the symptoms that we have since named under "Eyestrain," and his remedy was a lens. The brilliant success attending so many cases of asthenopia has given such confidence to an army of glass fitters, that it has become very easy to induce the people to wear a saddle on the nose for infinitesimal errors.

The mechanical perfection of grinding the glasses and the mounting of them in attractive frames have given optometric science in America a world reputation.

In the adolescent period of scientific medicine, the expres-

sions describing symptoms are proverbially more or less vague. The symptoms given by Donders in his work were, "morbid condition of the eyes," "dimness of vision," "affection of the retina from excessive employment," "disposition to fatigue," "slowly adjusting sight." However he says "the phenomena of asthenopia proceed from nothing else than from fatigue of the muscular system of accommodation"—which is the keynote of his system.

The more intricate apparatus of the motor system of the eye was not considered by him, and has been since sadly neglected, although I find that more than half of the cases of eyestrain are from anomalies of the extrinsic muscles. The glassing of so many, old and young, is no proof of such prevalence of errors of refraction as a cause, as this would be interpreted. With refractive errors of less than one diopter spherical, or a half diopter cylinder, when the axis of that cylinder is at vertical or horizontal axis and vision $\frac{20}{20}$, glasses are entirely unnecessary in the young subject, and sometimes injurious, ***when the motor apparatus is first put in order.***

Bohne, before Donders, attributed these symptoms to a weakness of the motor nerves of the eye, but his idea was submerged in the attention to ametropia.

Hyperæmia of the retina with sometimes ametropia and amblyopia was recognized quite early, but all of these symptoms were expected to be relieved in correcting the "hypermetropic structure of the eyes," or was passed over as something that could not be reached.

The literature of ophthalmology for the next two decades has been overburdened with theories and devices for the discovery of anomalies of accommodation and muscles, and for the conquering of them, and specialists of the eye became divided into two factions on this subject; on the one was the doctrine that the cause lay in ametropia; on the second that "imbalance" of the muscle system was a frequent cause. The first sought the glass to correct, and the second is supplemented by tenotomy.

The theories of Donders went almost unchallenged until Dr. Dyer at the second annual meeting of the American Ophthalmological Society in New York in 1865 reported several cases of severe asthenopia who had no hypermetropia, but with

absolute pain, and who had ceased to use their eyes, and some sat continually in the dark.

A number of the oculists present had had the same experience in their practice, and testified in like manner. At this meeting, Dr. Noyes used the expression of von Graefe: "Insufficiency" with "extreme irritability of the retina" which gave some indication as to the cause. Dr. Dyer, in explanation of the condition of these cases, said "that there is a want, a discrepancy of the relative accommodation, or a discrepancy between the power of the internal recti and the ciliary muscle." His idea was that "if the hypermetrope had a glass given him, of course the range is altered." He "changed the relation of accommodation to the angle of convergence by glasses," exercising at the near point at stated periods. Thus was born to the profession in America, gymnastic treatment of the ocular muscles, though crude in adaptation.

Between this time and the session of the International Ophthalmological Congress, which met in New York in 1876, Dr. Noyes did much in making differentiation between accommodation and muscular asthenopia, discovering many symptoms, mostly reflex. The definition of asthenopia from that time was gradually expanded to that of any symptom of pain or discomfort in the physical system, wherever found, which could be traced to the eye as a cause.

Dr. Noyes's paper at the International Ophthalmological Congress in 1876 on *Deductions Respecting Asthenopia* says that von Graefe admits that the hyperæsthesia of the retina is associated with a certain degree of accommodative and muscular disturbance but acts an inferior part of the mischief and "offers no outlet for successful treatment," that he "assigned the primary lesion to undue sensibility of the retina, or to neuralgia of the nerves of sensation." Dr. Noyes regards this diagnosis as "one which too often gives cover for imperfect examination—either through haste or neglect, or incompetency of the oculist," and says further, "I am not sure but that we will yet discover some hitherto unknown cause for the exalted irritability in a constitutional dyscrasia or some abuse of the eyes. . . ."

During the decades about the last years of the nineteenth century, and the beginning of the twentieth, the muscular

apparatus grew in importance and eyestrain was found due to the muscular system in a high percentage. There grew apace among the tenotomists the terms "insufficiency," "imbalance," "tenotomy," "torsion," and other hypothetical phrases, and these cases were almost universally given over to the correction by surgical interference, or by the artificial means of bending the rays of light to the eye pulled out of line by the recalcitrant muscle or muscles, which allowed them to proceed on their mischievous wayward course, and then were followed by a stronger prism, etc. These processes in the new light are seen to be makeshifts, substitutions, and apologies.

The common practice of using hand prisms and presenting a prism, say 5°, then laying it down and picking up another of greater or less denomination, is very awkward, unscientific, and ineffective, because: 1st, The strength of the prism is generally far greater than the muscle is able to overcome at a "jump." To find the succession of the proper denomination, it is necessary to pass through degrees the muscle overcomes easily and to add to it intervals that are adapted to that particular muscle. 2d, The lens thus handled by hand is not apt to be in true axis. 3d, When laid down as above described, if it has been overcome, the eyes have to "jump" the full amount of the next lens instead of a difference between, as in a battery of lenses. 4th, The lenses used in this way, no doubt, sometimes touch the eyebrows and the eyelashes. Soon the patient becomes tired and nervous before much, if anything, is accomplished. The most of these cases have a dread of motion and cannot endure the manipulation before them. We can see that orthoptic treatment has not been properly tried. There are a few cases that improve under it, but the majority thus treated do not respond. I sometimes prescribe a set of hand prisms for exercise to keep them from relapsing.

I have been assiduously at work on this problem, commencing early in the '90s, and have from time to time published papers and a book entitled *New Findings in Ophthalmology and Otology*. I examined the eyes of five hundred pupils in the schools of Des Moines, Iowa, through which and with my private practice and the clinics of the Medical College of Drake University I became acquainted with the character of these

muscles and learned to handle them. I soon realized the extensive field of the ophthalmologist which has not yet been properly worked.

The results of treating asthenopia by gymnastics was more satisfactory than my sanguine expectations imagined. It encompassed many symptoms already enumerated as accommodative asthenopia, and others of difficult differentiation, and included many more remote and obscure ones, and trespassed on syndromes thought to belong exclusively to other specialties.

I will not here take space to compare the differences in results between the refraction method in dealing with asthenopia, and that of gymnastics of the muscles. I have written much already on that point. On my more intimate acquaintance with these muscles, I gradually became convinced of the fact (or at least of the working principle) that all of the muscles were alike as to function in maintaining equilibrium at rest, and harmony in effort; they differ in construction, or physical ability, for the differences demanded of them in excursion: some much more elastic, compared with the stiffness in others; the lateral, for instance, made perhaps three times the excursion of the vertical; the verticals respond more slowly to discipline than the laterals, and are most apt to be found receding from the amount gained from day to day, but this is not difference enough to abandon the idea that the verticals cannot be regarded under the general principles of orthoptic treatment. Some abnormal conditions show spasmodic action as in squint, but it is yet to be proved that this phenomenon in strabismus convergens has not the same general cause (in addition to excessive accommodation) that I here attribute in general to asthenopia.

This method of treatment is approaching the subject by the path of *function* on which I have been able to find relief in so high a percentage of cases, rather than by the mechanical-repair-method, as the one worked in the "imbalance" theory.

The imbalance conception of anomalies does not recognize asthenopia in the (at least) 50% of cases that have no imbalance of any consequence. The worst cases I have treated were those with neither imbalance or errors of refraction, that amount to anything. There are symptoms in thousands of asthenopic cases that are presented to the practitioner and are

difficult for the patient to describe, and for which the cause has been sought in every organ of the body, but which effort has been, at last, thrown into the waste basket with the declaration that "there is nothing the matter with you," and the patient given a moral lecture on self-control.

Much labor has been spent to find a "latent heterophoria." This is a myth. Refraction is more easily and more certainly made when the field is clear of the causes of spasmodic action of the muscles.

In the literature of asthenopia some of our authors have been able to depict symptoms with graphic psychological clearness, but stopped short of ætiological accuracy and consigned the indications to an unknown and unfound error of refraction, while others believed the undiscovered cause to be in the mysterious motor apparatus; but many of the strange symptoms and their effects on the mental and moral character, they attributed to dyscrasia, corrupted training, or mental turpitude.

After finding this treatment relieved many persons who had appealed to men of the best reputation in the country, and who changed glasses, or either prescribed for diseases of remote organs or told the patients there was nothing the matter with them, I believe that proper attention to this apparatus will give more satisfaction in removing asthenopic symptoms than the fitting of glasses, now so exclusively practiced.

It is hardly fair for physicians to assume the attitude of an infallible sage with the "I am" argument towards patients who are not insane and willing to consult ten or fifteen of them and pay their fees, to "make rather light of their troubles" or pronounce them as having "too vivid an imagination and fretful under their disabilities" and to give them moral lectures. I have learned from seeing so many of these "rounders" that we as symptomatologists should be in a more receptive attitude towards the recitation of the strange symptoms of those who seek relief; a wider compass and more zones of syndromes are yet to be recognized as relating to the organ of vision than is generally believed; the many unaccountable desperations of individuals have more of a physical cause than is generally believed.

I would not be understood as decrying the correction of

ametropia, when the degree of error is of importance. I only condemn the exaggeration of this remedy, by putting on glasses of so weak a denomination that it becomes ridiculous and even a direct fraud, and repeating it with slight changes, passing over without thought a closely associated function where there is a possibility of better success.

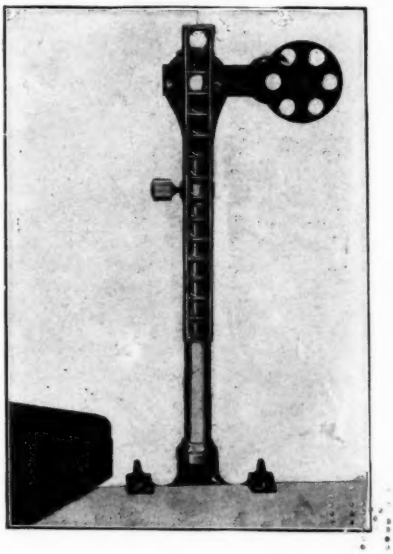
Then again, the majority of cases that require glasses, need also the treatment of the muscles of convergence, and if I am not mistaken with regard to my pathology of asthenopia, this exercise would give better success to glass fitting.

Starting, as I did, from the conviction that these motor muscles could not perform their work because of their weakness, I arranged the means to give them muscular discipline or gymnastics, by prisms with gradually increasing power, in batteries. The training of the muscles of the eyes, was a new field and there were no instructions to be had, so the adventures in the process were numerous and mistakes were inevitable.

I constructed an instrument in connection with these batteries, I named ***kratometer***, on principles I regarded necessary to call these muscles into action, believing from general principles, it was not rest they needed, as had been advocated, to cure muscular difficulties, but work under proper restrictions and care. In recognition of the difference in character of these muscles, I made the intervals in the batteries of lenses to correspond. To be more lucid, I may put it in this way; there were 50° units from parallelism on the convergence act, and sometimes 30 or 40 on the other side from parallelism. The interval between the prisms for these was one degree. The external recti, to get to standard, there were 16 units of a half degree. With the verticals there were 12 units to get of one-quarter of a degree.

To present these batteries to the fusion sense to induce action of the muscles, they were run in a groove with the axes of the lenses with the pull of the muscle, and on a plane with the face of the patient, gradually increasing the strength and acting smoothly until reaching the inability of the eyes to fuse the object (which is a light). Then the battery is withdrawn, and the patient is allowed to rest for a few seconds before another lift is attempted. The appealing to the muscles by small intervals, with regular rhythm is especially efficacious, and particu-

ILLUSTRATING DR. HAZEN'S ARTICLE ON "THE MOTOR MUSCLES OF THE EYE."



larly toward the end of the lift to break up the inertia from long idleness.

By this process I have been able to discipline one set of muscles as effectively as another: that is I could get a unit with the adapted lenses on the vertical as well as on the laterals, and so discipline the verticals and correct the heterophoria in either.

I was very much surprised at the results in relieving asthenopia, especially in cases that had been glassed a number of times before, and I could not reconcile the quickness of the relief, and its permanency, to the idea of repair of the muscle structure or the nervous weakness.

I found several cases, also, that were relieved of serious symptoms in persons who had no idea that they had any defect of the eyes.

I soon realized that this instrument was a powerful and effective one on the muscles, and required great judgment and care in its use. By it one can break down the lifting power, more quickly than by over use of the eyes in vocations. At first I exercised twice a day, latterly once a day, making but five to seven lifts at a sitting.

It is generally conceded that the point of rest of the straight muscles of the eyes, is at parallelism, at least when the eyes are open, and if there is no obstruction, or no abnormal nerve force interfering, the sense of fusion will always bring the axes of the eyes to this law of balance or rest, but when found out of balance, it must be from this interference of the law. This *im*balance, then, is a symptom and not a disease. The inquiry of Dr. Dyer is a very natural one: "Why is it that accommodation, convergence, and torsion did not bear their proper relation to each other, and Why is there obstruction?"

In bringing these muscles to their standard of strength by my instrument, I have found as a rule, that the imbalances, found at the beginning, were corrected. Sometimes, however, there has been a slight 'phoria at the finish, but as the treatment has given freedom of action of these muscles, the small imbalance would soon be corrected by the fusion law, for nature is economical enough to bring the resting point to the starting point for action. This expectation I have found to be the fact in many that I have had the opportunity to test after-

ward. But the imbalance left is not felt, for the muscle is now able to overcome it with ease.

Associated with most all varieties of muscular asthenopia, and many of pure accommodative asthenopia (if there be such) there is congestion of the vascular system: a chronic hyperæmia. Sometimes only the vessels of the outer coat, conjunctiva, which often gives a sunken and lifeless, soggy appearance, sometimes dry and sometimes watering. In other cases the congestion gives a pink color to the lids, showing a congestion of cartilage and surrounding parts, tending to styes or blepharitis marginalis. The congestion of the retina is often found, termed retinal hyperæmia or hyperæsthesia, with intolerance of light. Many cases of this nature wear colored glasses, and there are all kinds of theories about the ray tints. Black glasses that shut off much of the light and dull the sensitive periphery of the retina, upon which the side objects call for movement of the balls to fix on another point, and in these cases there is a dread of motion; with some it is the bane of their existence. They soon become stiff in their manners. In advanced cases there is deterioration of vision, often progressive exophoria. The eyeballs in the latter form are quite white and healthy in appearance.

These subdivisions I have made in the different phases of anomalies, are in consonance with the oculist's experience in treating inflammatory diseases of the eyes, viz., that one layer can be affected without implication of another. The anatomical distribution of the vessels explain it. When the eyestrain has been of long duration, the congestion is apparently "deeper seated" and requires, accordingly, more treatment.

The question whether the ciliary muscle is not alike affected as in other kinds of asthenopia with the same pathological condition, is open for experience, and that pathologically there is no difference only in degree.

The proposition so laboriously worked on, that some of the muscles are too long or too short (not well matched), or are inserted too far back, or too far forward in the capsule of Tenon (misfit), becomes a myth under this study. Muscles have a wonderful adaptation, if the hygienic conditions are right.

We come now to the question of pathology of eyestrain. In all the discussions of the probable ætiology of eyestrain, the

idea of a septic deposit as a cause of asthenopia, has not been advanced, but I believe it to be the proper doctrine. That this organ with its muscular organism, and so constantly at work should sometimes be a subject of unsanitarian laws, is a reasonable conjecture. The ophthalmoscope reveals a condition of the inner membrane that has not been interpreted, or a means to get rid of if found, and is the condition observed in many muscular anomalies. We most always find congestion of the retina; with this hyperæmia every oculist is familiar. In the stages of degeneration, leaving out those of hemorrhage, toxin, uræmic, diabetic, and reflex, we have a gradual increasing amblyopia, which progresses to the condition of perception of light only. Intolerance of light is often a symptom at first. Some authors describe hyperæsthesia of the retina, but after refracting, prescribing rest, and putting on colored glasses, there is nothing further done unless neuro-retinitis or some other actual disease that might be suspected or feared is found.

The application of glasses, though a good one, and is all that is needed with some, is a mechanical proposition to relieve "fatigue," and nerve irritation, and it materially lessens labor in focusing, but it does not add anything hygienic. It is doubtful in my mind whether it ever cured asthenopia; there are thousands who have laid their glasses off, finding no relief in the experiment.

The quick relief of asthenopia by my gymnastics given to strengthen the muscles and restore them to use, has, at the same time, removed the congestion and amblyopia, and often made me wonder what I had found. Cases that had been suffering for years, were relieved with less than ten treatments; car-sickness, sickheadaches, cases of intolerance of light, with from 25 to 35 treatments; and cases of exophoria or exotropia, to the extent of 25° or more, with an amblyopia that reduced vision to mere perception of light, were brought to parallelism, and to convergence of 40° in less than one month's treatment, with vision for reading common print by the unused eye.

This result has been attained not only in giving the muscles strength, but I believe by *pumping out the sepsis from the capillaries and tissues, the products of hyperæmia and inflammation,*

and thus giving them free action, and not as was at first thought, that it was giving the muscle more nerve power. I believe this clogging up of the vascular system with this debris, is the cause of the pain, both in muscular and in accommodative asthenopia.

I always treat the extrinsic muscles at the far point, and the accommodation has improved by several dioptries, even at the age when presbyopia first appears.

This hygienic improvement of the eyes upon this treatment explains its character of permanency, for not more than one in twenty relapse in two years. To arrive at a means by which the general healthfulness of the eyes can be brought about, must certainly be appreciated.

Of the weakness of the muscle and the sanitary condition named, which is the primary and which is the secondary, is left for the pathologist to determine, but if my conclusions are correct in this essay, the muscular apparatus outranks in importance refraction, and should be the first administered in the cure of asthenopia.

The office of these ocular muscles is not yet sufficiently appreciated. They are the quickest muscles of the body and are built for speed (fibers end to end—Maddox). In health the two eyes act as one and act together in establishing our consciousness of orientation, that is, we are able by it, to measure distance, relation of objects to each other, and to ourselves and hereby give individual and personal assurance. In health this is done instantaneously. In crossing a crowded thoroughfare the fixing of the eyes is changed, perhaps a thousand times. The side objects, especially if moving, call attention by the very sensitive periphery of the retina, and the eyes fix from side to side by bringing the fovea centralis of the retina into line quicker than a wink, and that without winking, the focusing function accompanying the fixing when required, and so safety is assured and the individual is able to "keep his head." If there is the slightest separation of the images of the two eyes there is blurring and confusion.

The new engineering profession of aviation, requires this faculty of quick fusing, and must be the most important requisite in successful flying.

In this kratometer system we have the artificial means of

testing this faculty, by throwing the image of the object that has already been fixed on the retina, to the periphery, by the use of its batteries of prisms. The same means can restore a defective fixation.

CONCERNING THE NATURE OF TRACHOMA; TOGETHER WITH A CONTRIBUTION TO THE NORMAL HISTOLOGY OF THE CONJUNCTIVA.

By Dr. KAZUO HIWATARI, Kioto, Japan.

(*With five illustrations on Text-Plate VIII.*)

(From the Acta Scholæ Medicinalis Universitatis Imperialis in Kioto, Japan.)

I. INTRODUCTION.

WE do not doubt to-day that trachoma is an independent infectious disease, although its specific agent has not yet been discovered. Aside from this, much remains to be explained about trachoma, and even the question as to what constitutes its most important pathological change has not yet been decided. The answer to this question is of importance both to the practitioner who deals daily with patients, and to the scientist who seeks to solve the problem of ætiology. The differences of interpretation, such as now exist between Lindner (1) and Loehlein (2), can, in my opinion, be reconciled only in this way.

Junius (3) believes the characteristic change to be the development of the granule in the adenoid layer of the conjunctiva, and that the other changes, though important from the practical point of view, are of secondary signification as regards the nature of the disease. His idea is that the eruption of granules is interwoven with the presence of adenoid tissue, and that as this disappears the trachoma is cured by transformation into cicatricial tissue.

Saemisch (4) thinks the essential feature to be a diffuse disease of the adenoid tissue which leads inevitably to the forma-

tion of cicatricial tissue, the formation of follicles to be nothing more than an accompanying symptom, and the importance of the granule to be slight so far as the pathology of trachoma is concerned.

W. and M. Goldzieher (5) thus state their conclusion: "Regarded from the standpoint of pathological anatomy trachoma is a disease caused by a specific agent as yet unknown and located in the vascular layer of the conjunctiva. The virus attacks first the vessel walls, the adventitial cells of which react to the specific agent with a lively production of lymphocytes, which group themselves into inflammatory granules. After dialysis of the specific agent follows a destruction of the perivascular proliferation, and parallel with it a new formation of connective tissue from the fibroblasts of the vessel walls that is synonymous with the end of the trachoma process, with its healing in the anatomical sense."

Ichikawa (6) believes that the histological picture found in both pannus and the scleral and palpebral conjunctiva, plasma cells, young connective tissue cells, and blood vessels is alone characteristic of trachoma. He excludes the follicle from among the characteristic changes because it is confined to the palpebral conjunctiva; to him it is only an anatomical impurity. He considers trachoma to be a diffuse granular inflammation of the conjunctiva which can, under certain circumstances, press forward into the cornea by way of a continuous propagation and so bring about trachomatous pannus.

Mutermilch (7) does not believe the presence of a specific agent necessary and propounds the theory that trachoma is one of the common chronic inflammations of mucous membranes which are covered with cylindrical epithelium and have adenoid conditions in their submucosa, having much in common with gonorrheal urethritis, uterine psoriasis, and atrophic rhinitis. He holds that there is no specific agent, that the various bacteria which cause acute conjunctivitis can also excite trachoma, that follicles and pannus are only accompanying symptoms which have no significance as regards the ætiology, course, and result of the disease.

According to Pascheff (8, 9) trachoma is not a simple inflammation, but a confluent, lymphadenoid, follicular hyperplasia of the conjunctiva and cornea which originates from the

special basis of the general lymphatic constitution of the body, as is now generally accepted to be the case with the lymphadenoid vegetation of the pharynx and nasopharynx.

Axenfeld (10) says that Ichikawa was incorrect in thinking that follicles do not occur in pannus. According to him follicles appear in pannus when the inflamed corneal tissue is sufficiently loosened up, and the process of trachoma alone is able to produce follicles.

In this brief collation it is striking how widely the opinions of the various authors differ. This difference of opinion may be ascribed, first, to the fact that hitherto authors have unanimously confined their studies to the conditions in the conjunctiva, without taking into account the general findings of pathological anatomy in other mucous membranes, and, second, that the normal histology of the conjunctiva has not as yet been sufficiently cleared up. The questions still remain whether the follicle is a normal constituent of the conjunctiva, what variations normally occur in the conjunctiva, and how the subepithelial layer is constituted. I will now present the results of my own investigations.

2. SHOULD THE TRACHOMA GRANULE BE CONSIDERED A TRUE LYMPH NODULE?

Most students of trachoma, like Bendz (11), Raehlmann (12), Villard (13), Pick (14), Addario (15), Greef (16), Junius (*l. c.*), Saemisch (*l. c.*), agree that the trachoma granule does not differ in its histological structure from a lymphatic nodule, though there are occasional students, like B. Jacobson (17) and W. and M. Goldzieher (*l. c.*), who deny this and consider the trachoma granule to be a sort of granuloma. My own histological examination confirms the findings of Saemisch and others, so a lengthy description may be omitted. One thing alone seems to me quite new and not without importance to the understanding of the trachoma granule, the migration of lymphocytes through the epithelial layer where beaker cells, as a rule, are wanting (Fig. 1). This phenomenon is constantly present in all stages of the development of the trachoma granule. The epithelial layer is thereby more or less permeated with lymphocytes and appears to be somewhat loosened up, the basal

cells are arranged rather more irregularly than normal, and the superjacent cells are more or less distinctly flattened. The extent of the epithelial layer showing this phenomenon of migration varies according to the size of the lymph nodule; with little follicles it is demonstrable in only a small series of sections and can very easily be overlooked. What is the meaning of this condition? Axenfeld (18) has seen it and illustrated it beautifully, but he took it to be a simple inflammatory infiltration of lymphocytes. I regard it as the imprint of one of the physiological functions of the trachoma granule, just as Stoehr (19, 20) did many years ago with the otherwise physiological lymph nodule. In favor of this theory is the fact that the number of migrated lymphocytes depends in no way on the intensity of the inflammatory symptoms, and the fact that the migration can always be demonstrated in fresh granules consisting of only a few cells. I believe that this finding supports the theory of the lymph follicle nature of the trachoma granule.

A word concerning the nature of the large mononucleated cells in the follicles which, under the names of phagocytes (Villard) and corpuscle cells (Leber), have been interpreted variously, both as to their histogenesis and as to their importance. Thanks to the vital stain we know to-day that the sessile reticulum and endothelial cells of the hæmatopoietic tissues and the star cells of the liver, the reticulo-endothelial histioblasts of Kiyono (21), under certain circumstances gradually become round and may become transformed by cell division into the mobile macrophages to which Kiyono has given the name of histiocytes. These histioblasts and histiocytes may take into themselves as phagocytes various elements from their surroundings. The histiocytes show a positive plasma reaction with the Unna-Pappenheim stain. There is now no doubt that the hitherto puzzling mononucleated cells of the lymph nodules are both morphologically and functionally nothing else than the histiocytes of Kiyono. They are a reaction product in the trachoma granule originating from the reticulum cells of the lymph nodule. Professor Kiyono was so kind as to look over my histological preparations, for which I offer him my best thanks. The cells held to be plasma cells by W. and M. Goldzieher (*l. c.*) in the commencing granule are in

my opinion not true plasma cells, but the same formations that have been demonstrated by Weidenreich (22) in the lymph nodules of the spleen and lymphatic glands and named lymphoblasts. Perhaps the common positive plasma reaction led the first named authors to their conclusion, but plasma cells and histiocytes differ in the structure of their nuclei.

3. IS THE LYMPH NODULE A NORMAL CONSTITUENT OF THE CONJUNCTIVA?

This question has received widely different answers. Krause (23), Henle (24), Schmidt (25), Kleinschmidt (26), Baumgarten (27), Schwalbe (28), and others regard the lymph nodule as a normal constituent. Stoehr (29) defended this view in 1885. H. Virchow (30) advocated the same in Saemisch's ***Handbuch***, as he had demonstrated a lymph nodule in the supposedly quite normal conjunctiva of a man twenty-three years old who had been executed. On the other hand Waldeyer (31), Stromeyer (32), Blumberg (33), Wolfring (34), Sattler (35), Reich (36), and others deny its normal existence in the human conjunctiva.

When the names of these authors are closely scanned it appears that those who held the first view were for the most part anatomists, while the second group was composed mainly of clinicians. The difference of opinion therefore is not due to the different materials handled.

Formerly I held the former opinion, but when I undertook to confirm it by a histological examination of the zone of plateaus and grooves (H. Virchow) and of the conjunctival fornix, macroscopically free from follicles, from several healthy persons, I could find no follicles in spite of a careful examination of series of sections. I thought this was because the follicles were not just where I looked for them. But it happened that I examined histologically a piece of conjunctiva from the lower fornix of a girl thirteen years old, which had a single minute bleb as clear as water. This bleb consisted of a very small quantity of lymphocytes and had in its middle no germ center (Fig. 2). This convinced me there are in the conjunctiva no lymph nodules not macroscopically visible. A conjunctiva in which no follicles are macroscopically visible, met with not

EXPLANATION OF THE ILLUSTRATIONS.

Fig. 1. Section from the upper transition fold of a trachomatous conjunctiva. About the middle is a young follicle with an indistinct margin. The epithelial layer covering it abounds with migrated lymphocytes. Hæmatoxylin (Boehmer)-eosin stain. Leitz, ocul. iii. and obj. 3.

Fig. 2. A very small lymph follicle, which appeared clinically as a minute bleb as clear as water, from the lower transition fold of a girl. Stain and enlargement the same as in Fig. 1.

Fig. 3. Section from the upper transition fold of a normal conjunctiva. L—lymphocytes, H—histiocytes, P—plasma cells, B—connective tissue cells. Stain as before. Zeiss compens., ocul. iv., oil immersion obj. $\frac{1}{12}$.

Fig. 4. Section from the zone of plateaus and grooves of a trachomatous tarsal conjunctiva of the upper lid. At A is a commencing follicle formation, at B a profuse proliferation of fibroblasts. The fibroblasts have pale nuclei. Stain as before. Zeiss compens., ocul. iv., obj. D.

Fig. 5. Section from the corneal limbus of a normal conjunctiva. In the right half the epithelial layer consists of laminated cylindrical epithelium. Stain as before. Leitz, ocul., iii., obj. 3.

ILLUSTRATING DR. HIWATARI'S ARTICLE ON "THE NATURE OF TRACHOMA."

FIG. 1. FIG. 2. FIG. 4.

FIG. 5.

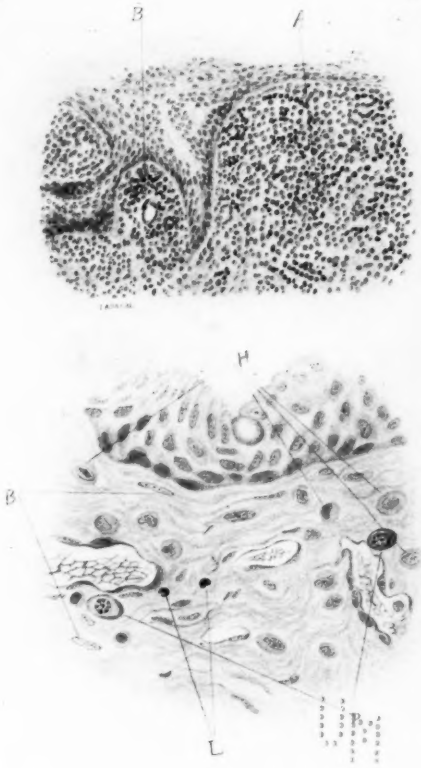


FIG. 3.

rarely in children, must be considered as truly free from follicles. A perfectly transparent conjunctiva through which the subjacent vessels and Meibomian glands are well visible, which also has a smooth surface, is therefore to be regarded as the normal, ideal condition of the membrane.

I now feel certain that the lymph nodule is not a normal constituent of the conjunctiva. I believe it to be a reaction product to the various sources of irritation that affect the conjunctiva during life. Its presence always indicates that at some time some sort of irritation has occasioned a formation of follicles. It is difficult to speak positively concerning the fate of any single nodule, but it is quite probable that it disappears spontaneously after the discontinuance of the irritation.

4. UNDER WHAT CONDITIONS DO LYMPH NODULES APPEAR IN THE CONJUNCTIVA?

Before entering upon this question, the fact must be presupposed as generally accepted that the lymph nodule in the normal mucous membrane, as in the gastrointestinal tract, exists as a protective apparatus, and that under certain circumstances it may react with hyperplasia to irritations there. General pathology has shown us that, when induced by irritation, lymph nodules can appear more or less abundantly in mucous membranes in which normally they are few or absent, as not infrequently in the bladder.

As the conjunctiva can form no exception in the pathology of the mucous membranes, we must consider the development of lymph nodules there to be quite analogous to what has been shown to take place in general pathology. The theory advanced by Raehlmann (*l. c.*), Greef (*l. c.*), Axenfeld (39), and Saemisch (40), that the formation of follicles in the conjunctiva is a reaction product due to external irritation, is not to be controverted. Still this simple explanation does not suffice; conditions in the conjunctiva are complicated. In the first place, atropine catarrh occurs only in occasional persons and one has to assume the presence of a second factor, a general predisposition of the individual. Pascheff (*l. c.*), as already mentioned, expressed a similar opinion in his explanation of the trachoma follicle. The specific irritation suggested by Greef (*l. c.*) seems

to me very questionable. In the second place, the formation of follicles takes place by no means uniformly throughout the conjunctiva; it appears by preference in the fornix and on the palpebral conjunctiva, while it is usually absent on the bulbar portion of the membrane and in pannus. To explain this it is necessary to assume the presence of a local predisposition.

It is hard to say upon what this general and local predisposition may depend, but certainly age plays no small part in the former. This is shown by the clinical experience that follicles are few in infants and in old age, while plentiful in childhood and youth. Whether the general lymphatic constitution of the body is of importance, as assumed by Pascheff (*l. c.*), remains undecided. As regards the local tissue predisposition, this has frequently been ascribed to the so-called adenoid nature of the subepithelial tissue, when it is assumed that the conjunctiva of the fornix and lids produce follicles abundantly because of an adenoid subepithelial layer while that of the globe and limbus does not because in them this layer is absent.

The first thing to be decided is whether the subepithelial layer of the conjunctiva of the fornix and lids is truly adenoid. The first author to assert it to be was His (cited by Zehender, 41), whose view soon found general approval so that it is now found in almost all textbooks on ophthalmology. H. Virchow (*l. c.*) rejected the theory completely, and this induced me to renew my study of the normal human conjunctiva.

The ground on which Virchow based his opinion was the fact that plasma cells were more numerous than lymphocytes in the subepithelial layer of the normal conjunctiva. My investigations confirmed this finding, but I also found that Virchow's plasma cells were not uniform, that they were divisible into two quite different kinds of cells, the histiocytes of Kiyono (klasmocytes of Ranvier), and the true plasma cells of Marschalko. The properties which these two kinds of cells have in common are abundance of protoplasm, excentric position of the nucleus, and positive plasma reaction to the Unna-Pappenheim stain. They can be clearly differentiated by the minute structure of the nuclei, as the plasma cells show a typical spokelike arrangement of the chromatin framework, while the histiocytes have pale, roundish or somewhat arched nuclei (Fig. 3), but the most essential difference is that the histiocytes take up the

coloring matter of the vital stain into their bodies, while plasma cells do not.

The presence of these histiocytes in the animal conjunctiva has been experimentally demonstrated by Rados (42), and by Schnaudigel (43), and it is hardly doubtful that they are present in the human conjunctiva also, although this has not yet been proved by the staining method. I believe that the greater part of the plasma cells in the conjunctiva described by Stoehr in his textbook of histology are identical with the histiocytes of Kiyono. I found these histiocytes preëminently in the neighborhood of the blood vessels, while the typical plasma cells were scattered sparsely here and there in the subepithelial layer.

The theory that the subepithelial layer of the conjunctiva fornicis et palpebrarum is adenoid can therefore no longer be held to be correct. Both it and the idea that the formation of follicles is connected with an adenoid nature of this layer must, in my opinion, be abandoned in the future.

This is not meant to imply that the nature of the subepithelial layer of no import in the formation of follicles in the conjunctiva. It is a settled fact that this formation takes place by preference in the conjunctiva fornicis et palpebrarum. Although the designation adenoid was not fortunate, yet it must be admitted that the conjunctiva of the fornix and of the lids far exceeds that of the globe in the abundance of cells in the subepithelial layer, and that the importance of this difference in the number of cells is not to be underestimated in the development of follicles.

The second morphological difference between the conjunctiva of the fornix and lids on the one hand and that of the globe on the other is that the epithelium covering the former is thin and cylindrical, while that of the latter is thicker and flat.

In what way do these two morphological differences, the varying number of cells in the subepithelial tissue and the different nature of the covering epithelium, establish a predisposition to the development of follicles? This is a very difficult question to answer. Yet it is probable that these conditions, though not alone, form the anatomical substratum of the local predisposition of the tissue. The question concerning the formation of follicles in the conjunctiva is still more com-

plicated because this membrane is, as rightly claimed by H. Virchow, subject to great individual variations in its structure, a matter to which I shall return later.

To summarize briefly:—Three factors are necessary for the formation of follicles; external irritation varying in strength and duration, general bodily predisposition, and a local tissue predisposition.

5. THE CHANGES IN THE SUBEPITHELIAL CONNECTIVE TISSUE OF THE CONJUNCTIVA IN TRACHOMA, ASIDE FROM THE GRANULES.

I have said already that the subepithelial tissue of the conjunctiva should not be called adenoid. Here we find the histiocytes of Kiyono in the greatest abundance, with less numerous plasma cells of Marschalko and lymphocytes. The number of fibroblasts also is increased.

The fact that in trachoma the fibroblasts are the earliest to proliferate can be demonstrated best in the region of the plateaus and grooves. This region, as indicated by its name, is characterized by numerous grooves with flat elevations between them (plateaus of H. Virchow). It not infrequently happens that one may find a plateau with a little follicle and another immediately adjacent with no follicle, both provided with many newly formed young fibroblasts (Fig. 4), together with the other kinds of cells mentioned above. This seems to me to show most clearly that the proliferation of fibroblasts in trachoma is not an accompanying symptom, but a sort of reaction of the tissue itself to the trachoma virus. Consequently I cannot concur in the idea that has been frequently advanced (*e. g.*, by Goldzieher) that cicatrization begins exclusively in the neighborhood of broken-down granules. It cannot be denied that after their contents have become softened by young connective tissue cells the granules are replaced and finally become cicatricial, but this mode of cicatrization cannot be regarded as an essential feature of trachoma. My idea is that the softening of the contents of the granule is rather a consequence of a cicatrization which develops gradually in the course of time in the tissue about the granules. A granule is composed of cellular tissue with a faulty vascular

supply; impaired nutrition due to cicatrization in the surrounding tissue finally induces a retrogressive metamorphosis of its constituents. Cicatrization may therefore take place quite independently of the granules wherever trachomatous infiltration is present, whether in the conjunctiva of the tarsus, fornix, or globe, or in the cornea. Ichikawa (44) has demonstrated that a trachomatous granular proliferation with consecutive cicatrization occurs in the bulbar conjunctiva.

In short, the changes in the subepithelial tissue in trachoma, aside from the formation of follicles, consist of a chronic, granulating inflammation with an increase of lymphocytes, plasma cells, and histiocytes, and accompanied by young connective tissue cells which finally lead to cicatrization.

6. WHAT IS THE NATURE OF THE TRACHOMATOUS CHANGE?

The lack of agreement in the answer to this question has already been indicated. Some authors, who consider the formation of granules to be the characteristic of the trachomatous change, believe the granule able to excite trachoma in a manner analogous to that in which the tubercle produces tuberculosis (Goldzieher, *l. c.*). Saemisch (*l. c.*), Ichikawa (*l. c.*), and others consider the change in the subepithelial layer to be of chief importance, Saemisch taking the granules to be simply an accompanying symptom, Ichikawa thinking them an anatomical impurity.

My own opinion is that both changes, the granules and the granulating inflammation in the subepithelial layer, are intimately associated with trachoma, because both originate as the result of the reaction of the tissue to the trachoma virus, and that it is improper to consider either as the one characteristic of trachoma, as has been done so frequently. So long as the granule is the result of a reaction of the tissue to external injurious influence it is wrong to exclude it from the list of trachomatous changes, and the same is true of the subepithelial proliferation. But in my opinion the latter far exceeds the former in gravity, for the proliferation of granulations in the subepithelial layer occurs only in trachoma, tuberculosis and syphilis being excluded, while the formation of follicles is met with very often in other forms of conjunctivitis. Ichikawa

(*l. c.*) formerly denied that follicles could occur in pannus and in the bulbar conjunctiva on the ground that the subepithelial tissue at the limbus lacks the adenoid nature which he thought was an indispensable precondition to their formation. This position is not tenable because it has been positively ascertained that occasionally, though rarely, follicles do occur in pannus. Yet the conclusion that the process of trachoma is always able to produce follicles, even in places where the so-called adenoid layer is normally absent (Axenfeld, *l. c.*, Komoto, 45, Meyerhof, 46), is in my opinion premature. For example Axenfeld (*l. c.*) says: "For the conjunctiva, in which the anatomical previsions are present, the follicle formation is characteristic of the trachoma virus. In the cornea they can never develop typically on account of the different anatomical conditions; it is only when a corresponding degree of loosening and a mighty layer of trachomatous infiltration has developed that follicles can appear here." If this view is correct it is essential that the pannus must be thick for the follicles to appear, but this is by no means the case. I can affirm from many years of experience with abundance of material that when follicles do occur they may be found in thin, quite small pannus. Many of Pascheff's (*l. c.*) illustrations indicate the same. Axenfeld's theory is therefore a mere surmise.

The formation of follicles in pannus and in the conjunctiva bulbi can be explained, just as in the fornix, by an exceptional special predisposition which favors the process there in certain cases, and we must not overlook the fact that the conjunctiva of the limbus and of the globe are particularly marked by variations in structure, as pointed out by H. Virchow (*l. c.*). In addition to many variations to be found here normally, affecting chiefly the number and strength of the papillæ, the thickness of the epithelial layer, and the number of beaker cells, I have found one which has never before been described—the occurrence of cylindrical cells in the epithelial layer. The bulbar conjunctiva is covered, as a rule, by laminated epithelium, and I was considerably surprised while examining histologically a normal conjunctiva at the limbus to find all the neighboring conjunctiva covered with cylindrical epithelium (Fig. 5). Unfortunately the sections were not arranged in series, so

I could not determine the extent of the area thus covered. This finding shows at least the possibility that occasionally an island of conjunctiva may occur at the limbus which is constructed morphologically like that of the fornix, a matter that must be of importance to the pathology of the conjunctiva. When trachoma invades such a conjunctiva follicles must surely form in the pannus without any such loosening as Axenfeld (*l. c.*) supposes.

Aokage (47) reported another condition which he interpreted similarly. In a boy sixteen years old he found close to the upper outer limbus a pale yellow, subconjunctival, movable tumor, half as large as a grain of rice, which was said to have been present since childhood, and to have increased in size rather rapidly recently, after the patient had had an acute catarrhal conjunctivitis. The histological examination of the extirpated tumor showed it to be composed of glandular lobules exactly similar in structure to Krause's glands. This proves that the subepithelial tissue at the limbus can have at times a structure morphologically similar to that of conjunctiva fornicis.

The formation of follicle at the limbus is therefore not to be interpreted in the way it has been by Axenfeld (*l. c.*) and Komoto (*l. c.*), but rather as the consequence of an occasional occurrence of trachoma in a limbus predisposed to such a formation by a variation in its structure. Without this inherent predisposition in the tissue trachoma can, of itself, produce no follicles in the limbus. The rare occurrence of follicles in pannus is to be ascribed to the lack of predisposition at the limbus, and this lack is explained by the rarity of the above-mentioned variations.

It is therefore incorrect to argue that the formation of follicles in pannus is a proof that trachoma is always able to produce follicles in the way that tubercles excite tuberculosis.

Although the follicles is a reaction product of the tissue to the trachoma virus and consequently is one of the trachomatous tissue changes, it is of much less consequence and importance than the proliferation of granulations in the subepithelial layer.

I cannot concur in the theory that lymph nodules occur also in the tarsus, as I have never found them there. The forma-

tion of lymph nodules in the lacrimal gland described by Matsuoka (48) may find its explanation in the presence of collections of lymph cysts, which are present normally in this organ, as Axenfeld (49) has long since shown.

7. CONCLUSIONS.

1. The substantia propria of the conjunctiva consists of a connective tissue layer permeated more or less richly with histiocytes of Kiyono, plasma cells of Marschalko, and lymphocytes, but with the last two in much smaller numbers. Contrary to the widely accepted theory the substantia propria has no adenoid nature, as H. Virchow rightly insisted.

2. Lymph nodules do not exist in the normal conjunctiva; they are always a reaction product of the tissue to some external irritation which may vary in duration and strength.

3. Two other factors take part in the formation of follicles in the conjunctiva, the general bodily constitution and a local predisposition.

4. These two factors are connected with the age of the person and with the anatomical structure of different parts of the conjunctiva. Sometimes the varying richness of cells in the subepithelial layer and the form of the epithelium, whether cylindrical or flat, are of special importance.

5. In addition to the formation of lymph nodules and the increase of histiocytes, lymphocytes, and plasma cells, a proliferation of fibroblasts takes place early in trachoma, so that a peculiar granulation tissue is formed in the subepithelial layer. Trachoma is, therefore, a sort of chronic granulating inflammation.

6. The proliferation of granulations and the formation of lymph nodules are both important in the pathology of trachoma, as both are reaction products of the tissue to the trachoma virus.

7. But the latter is less important than the former; for wherever trachoma breeds harm the proliferation of granulations occurs with consecutive cicatrization, while follicles are absent where the local predisposition is lacking, as in the bulbar conjunctiva and pannus.

8. Follicles do occur in pannus, but this does not mean

that trachoma as such and by itself is able to produce follicles as claimed by Axenfeld and Komoto. The rarity of such an occurrence contraindicates this. It is only occasionally, when an anatomical variation at the limbus gives a favorable condition, that follicles are formed.

9. Such a variation may sometimes be due to the presence of cylindrical epithelium in the epithelial layer, as I have shown. Aokage's finding was also a sort of variation in the subepithelial layer.

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ATYPICAL ALBUMINURIC RETINITIS.

By Dr. C. A. CLAPP, Baltimore, Md.

(With two illustrations on Text-Plate IX.)

ONE becomes so accustomed to think of albuminuric retinitis in the form of star-shaped exudates, and especially is this so of internists who are using the ophthalmoscope upon their nephritic cases, that I believe it wise to briefly record the history of the following case with drawings of the fundi.

A. M. (Male.) Age 18. Was first seen September 28, 1912, complaining of headaches. Patient had tonsils cut and adenoids removed several years previously. Examination showed stumps of tonsils which were fairly healthy with large mass of adenoids. The adenoids were ordered to be removed and small error of refraction corrected. Fundi normal; headaches relieved. In April, 1914, there was a slight change in refractive error under atropin but fundi were normal.

Patient entered Johns Hopkins Hospital in June, 1918, at which time a diagnosis of acute nephritis was made and stumps of tonsils removed.

Consulted us again on January 28, 1919, stating that vision had been defective since his illness in June, 1918, but that he seemed to be seeing a little better than at that time.

Examination showed slightly dilated pupils, but both reacting to light with a vision of $\frac{20}{200}$ in each eye, not improved by lenses.

The right fundus showed (see Fig. 1) slight fullness of nerve with beginning pallor, vessels full and tortuous. In macular area there was a small round circumscribed area of a pearly white appearance, near the circumference of this area was a small amount of pigment; surrounding this small circumscribed area which seemed to be slightly depressed

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ILLUSTRATING DR. CLAPP'S ARTICLE ON "A TYPICAL ALBUMINURIC RETINITIS."

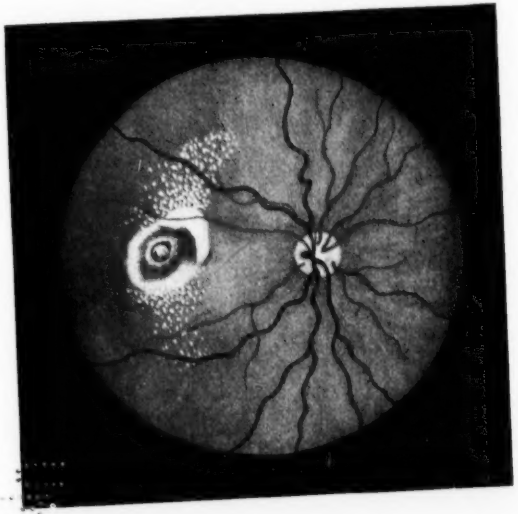

FIG. 1.
Right Eye.

FIG. 2.
Left Eye.

was a large yellowish white area several times larger than the nerve head with an irregular area of pigment collected between the center and its circumference extending from the small central area over the larger yellowish white area were very fine white lines, probably connective tissue trabeculæ; superimposed over the pearl white center were some very fine droplets suggestive of fat drops. These were focused 0.5 D. in front of circumscribed round area: above and below the large yellow area were the ordinary fine yellowish exudates.

The left eye showed (see Fig. 2) a very similar change except that the condition seemed more recent, in that the outlines of nerve were more blurred, probably slightly more retinal œdema, and the central pearly white area was not so circumscribed and the collection of pigment in this area and in the surrounding yellowish white portion was less pronounced than in the right eye, the fatlike droplets over central area were larger and more numerous with practically no radiating connective tissue strands from macula; the small exudates above and below the central mass were also fewer in number.

From the scientific standpoint we regret that we cannot complete the study by a microscopical examination and one is almost tempted to think that this is not a case of albuminuric retinitis, but the diagnosis of the internist after a very thorough survey and with a negative Wassermann was acute parenchymatous nephritis so our only alternative as we see it is to record it as "Atypical Albuminuric Retinitis."

REPORT OF THE TRANSACTIONS OF THE OPHTHALMOLOGICAL SECTION OF THE ROYAL SOCIETY OF MEDICINE.

By Mr. H. DICKINSON, London.

An ordinary meeting of the Section was held on Wednesday, June 4th, under the presidency of Mr. W. T. Holmes Spicer.

Mr. J. Herbert Fisher exhibited, by means of the epidiascope, a life-size drawing through the center of the optic chiasma, to show the pedicle of the pituitary body and the intimate relationship between the lateral boundary of the pituitary body and the inner wall and internal carotid artery. This artery, having come forward in the floor of the cavernous sinus, made a bend with its convexity forwards as it ascended to pass on the mesial aspect of the clinoid process on its anterior aspect. It also showed the ophthalmic artery coming off. Mr. Fisher considered that if there were a swelling of the pituitary body, of either a transient or permanent nature, it was very likely to cause an immediate effect on the carotid artery in the way of indenting its inner wall and so interfering with the blood flow, and producing thereby an effect on the cerebral, and possibly also the retinal, circulation. This section seemed to support the view he recently brought before the members, that possibly an abnormal state of the pituitary body might be responsible for some varieties of migraine, and explain such attendant symptoms as aphasia. Some further support was derived from the fact that during an attack of migraine it was common for the superficial temporal artery to be tense and cordlike. If the enlarged pituitary caused compression as he suggested, then more of the blood brought up the neck by the common carotid must be diverted and fill up

the branches of the external carotid, of which the temporal artery is the most easily investigable.

Mr. L. V. CARGILL showed a case of **pigmented connective tissue** in front of the optic disk of the left eye. When this soldier was in France, he was struck in the face by shrapnel in 1918. As the man was complaining of blindness, his condition was described there as evulsion of the optic nerve. It did not have that appearance, however. The history showed that the man had had no vision in that eye before he was recruited. The disk of the left eye was practically hidden by this mass, which projected beyond the level of the fundus some 3 to 5 diopters. From some of the radiating white streaks, blood vessels could be seen to emerge. He thought it must be due either to some defect of a congenital nature, to trauma, or to inflammatory change. His view was that it was due to a hemorrhage, which might have occurred at birth. Obviously it had no relationship to the facial injury by shrapnel.

Mr. F. A. JULER showed a patient with **obstruction of retinal vessels, with patent vessels,** following an electric flash. This case of embolism of the central artery of the retina showed some unusual features. The part of the retina on the outer side of the disk looked healthy and was not opaque, and there was a small cilio-retinal vessel supplying this part of the retina. With regard to the nature of the obstruction, the man had an extensive heart lesion, which Dr. Langmead regarded as probably congenital. At this date, a fortnight after the onset, the retinal arteries of this eye had as large a caliber as that of the other eye vessels. The existence of the heart lesion made it difficult to escape the view that the obstruction was due to embolus in the central artery of the retina. The man was engaged in his electrical work, when a flash took place about six feet from him, and two hours later the eye was gradually becoming blind. An hour later the sight came back almost completely. When, however, he went to sleep shortly afterwards he awoke with the eye again blind. The diminished force of the heart's action during sleep probably enabled the blockage of the artery to again become complete. The question of compensation having arisen, he gave the view that there was a causal connection between the flash and the blindness.

Mr. FOSTER MOORE exhibited a case of **melanoma of the choroid,** which had remained stationary for five and a half years. It showed the characteristic "blue ointment" color, which was uniformly distributed over the growth. It was only discovered on routine ocular examination. The pigment appeared to be intracellular.

Mr. E. M. EATON contributed an exhaustive paper, illustrated by many slides, on **visual perception of solid forms.** He showed that the binocular element was the essential factor in stereoscopic vision. The stereoscopic quality was not an exclusive attribute of binocular vision. It must be recognized that as experience was added, sensation came more and more to assume an objective character, and ultimately it became undifferentiable from perception. This was not equally true of any other sense, if indeed it were so at all. In the ordinary view of objects there was no conscious relic of the abstract sense of light: there was merely an impression of the perception of the object seen. It was possible to so suppress the image of each retina that each perception was a composite view made up of part of the image of one eye, and part of that of the other. If two retinal images did not fit each other satisfactorily, it was possible to automatically cut off the projecting portions. In fact, in only a few circumstances did one utilize the whole of both retinal images. When it was said that by means of binocular vision a view could be obtained around objects, it really meant that spaces behind them could be appreciated, as in looking across a sandy desert in sunshine and perceiving the air agitation due to altering states of atmospheric density and therefore refracting power.

COLONEL J. H. PARSONS spoke of the great value of the paper, especially in connection with the visual problems of aviation. He said the contribution invited very careful study.

The Section held its first meeting of the season on Wednesday, November 5th, under the presidency of Mr. W. T. HOLMES SPICER.

Dr. RAYNER D. BATTEN showed a case of **acute disseminated choroidoretinitis,** of doubtful origin. The changes all took place practically while the patient was under observation. He

was first seen by the exhibitor at the end of March last. Three weeks previously to returning home demobilized, he had lost central vision in the right eye. A nearly flat subretinal patch was found to the temporal side of the optic disk, below the superior branch of the retinal vessel. It was about one third the size of the disk, and was triangular in shape. A small retinal vessel passed over it, and it was surrounded by an area of œdema. The remainder of the right fundus and the whole of the left fundus were normal. The eye was examined about once a week. Towards the end of May, the whole of the right fundus was thickly strewn with patches of choroiditis, and these could still be seen in much the same condition. The central patch had now subsided, and the vision had improved. As the appearance was strongly suggestive of syphilitic choroiditis, a Wassermann test was twice done, but was negative: there was no other evidence of that disease about the man, and he strongly denied the possibility of such infection. In December, 1916, when on military service, he had a wound on the foot, which was very tardy in healing. The area of the wound was still tender to pressure. A surgeon had declined to open up the foot again, on account of the stubborn healing on the former occasion. In August last the vision was: right $\frac{6}{18}$, left $\frac{6}{6}$. When seen on October 2d, there was a history of sudden failure of vision in the left eye three weeks previously, with a central black spot. Later, a similar condition was found in the right eye, the vision in that eye being $\frac{6}{6}$, the vision in the left having been reduced to $\frac{6}{36}$. He asked opinions as to the likelihood of further attacks, and as to the probable causal agent.

The PRESIDENT thought the involved area was raised above the general level of the fundus, and his view was that the cause was sepsis, from the original focus in the foot.

MAJOR J. F. CARRUTHERS, R. A. M. C., showed an unusual case of **optic nerve tumor.** The patient, 21 years of age, was not aware of anything wrong with his vision until he was 14. His attention was drawn to his eyes, however, by increasing dimness of sight of one. As his other eye was good, however—it was still $\frac{6}{6}$— he paid no attention to it. He later had dragging pain at the back of the eye, and last June he attended the Herbert Hospital for treatment. A consultation was held,

and operative measures were discouraged. The man returned to work, but came again in July, and then the eye was found to be quite blind, and the pupil did not react to either light or accommodation, only consensually with the other. The pain he, the speaker, did not attach much importance to, as it did not seem to deter from sleep or enjoyment. There had been no injection of the conjunctiva, and the media were clear. In July, there was a pearly-white organized mass covering the whole anterior surface of the optic nerve: no hemorrhages nor even vessels were apparent in or on it. There appeared to be a retino-choroidal rupture, and the structures inside a pigmented ring were evidently being drawn towards the under surface of the tumor. There was very little sign of progress since July.

Mr. HUGH THOMPSON, who saw the case in June, thought it was probably a birth injury to the nerve, a view in which several colleagues agreed. With the exception of a little more pigmentary disturbance, he saw no evidence of advance.

Mr. M. S. MAYOU suggested the possibility of the tumor being tuberculous, and asked whether the man had been investigated from that point of view.

Mr. LESLIE PATON referred to a similar case, though of less degree, which he showed before the Ophthalmological Society ten years ago. In that case there was no sign of rupture of the choroid. The discussion on it showed that most members considered it a congenital malformation in the connective tissue of the disk. The question whether or not this growth was progressing was an important one in considering whether the eye should be removed.

COLONEL PARSONS said Mr. Paton's case was one in which there was a little mass at the edge of the disk. There was no absolute proof that the lesion was a growth. The eye was excised. The section gave an appearance exactly similar to Coats's disease, exudative retinitis; it was in a very early stage. He thought it very likely that the present case was one of birth injury at the head of the nerve, with subsequent cicatrization.

MR. TREACHER COLLINS suggested that there had been some hemorrhage into the vitreous, and that the white mass in front of the vitreous was organized fibrous tissue.

MAJOR CARRUTHERS replied that no tuberculous or other disease was found at the medical examination, and the urine was normal.

Mr. H. R. JEREMY and Mr. MCMULLEN showed cases of **supposed avulsion of the optic nerve head.** Mr. MALCOLM HEPBURN did not agree with the description.

COLONEL PARSONS exhibited a case showing **bilateral changes in the macula.** When the young man's mixed astigmatism was corrected, his vision was practically normal. He entered the army unaware of any optical defect, and remained three years, until he was examined again before leaving for Egypt with a draft. Then Mr. Secker Walker, of Leeds, finding the macular changes, quite rightly secured his release. The changes were of long standing, and he thought it likely they were caused by colloid bodies in the choroid. These bodies were usually found in elderly people, but they were found in young subjects of retinitis pigmentosa.

Mr. TREACHER COLLINS thought the condition was probably retinitis circinata, *i. e., hemorrhages into the retina itself,* organizing into white masses. The white patches round the disk seemed to be too extensive for ordinary colloid degeneration.

The PRESIDENT took the same view of the case as that expressed by Colonel Parsons. In retinitis circinata there was, he believed, always some loss of vision, and generally the macula was very gray in appearance, what had been well described as a "Passover bread appearance"—white masses with black holes in them.

Mr. R. R. CRUISE showed a patient six months after a **plastic and grafting operation on a damaged socket** for the purpose of wearing an artificial eye. It showed either that the conjunctiva had encroached at the expense of the skin, or the graft itself had been so altered by the constant orbital moisture as to approximate to conjunctiva. He reëmphasized the points he made when showing the case before the Ophthalmological Society six months ago.

The PRESIDENT expressed the congratulations of the Section to Mr. Cruise for his skill.

Mr. SIMPSON showed a case of **probable partial avulsion of the optic nerve.**

Dr. RAYNER D. BATTEN then read a paper on

The Need of Ophthalmic Physicians for the Advancement of Ophthalmology.

Dr. Batten said the question discussed in his paper arose when a vacancy occurred on the staff of the hospital to which he is attached and he urged that an ophthalmic physician rather than a surgeon was required. His arguments in favor of such an appointment were met by the reply that it was "not done" at other hospitals, and that, moreover, no men were available who had been educated for such a post. He was invited to bring forward the matter at the Royal Society of Medicine, and he now asked for an expression of opinion from members of the Section, not only as to the appointment of ophthalmic physicians for ophthalmic hospitals, but on the whole question of the education of ophthalmic men.

Cases requiring direct surgical treatment formed such a small part of the ophthalmologist's work, that he had to be responsible for a far larger clinic than he could personally attend to if it was to yield sufficient operative material for the study and advance of the specialty. Hence large numbers of men were educated and given posts as clinical assistants and given much responsibility: they became able ophthalmic observers, but were given no training in ophthalmic surgery, while their knowledge of medicine was insufficient to make them ophthalmic physicians. The further advances in ophthalmology promised to be mainly on medical lines, therefore men with a physician's training and experience would be needed. New operations might continue to be evolved for glaucoma, the best form of cataract extraction could still be discussed, and some day there might be a successful operation for detachment of the retina or for conical cornea, though he doubted whether success in these conditions was likely to come from the surgical side. On the medical side, however, there were endless possibilities, which the ophthalmologist tried to tackle with his detached scraps of medical knowledge. The position of physicians attached to ophthalmic hospitals was that of consulting referees: they did not have patients of their own, for which they were answerable. Even in well-marked medical cases, the responsibility rested with the surgeon. In private practice, the responsibility was, more often, shared: and here,

even if a case was referred to a physician, he was seldom in a position to study it from the ophthalmic point of view. At present the consulting physicians were not appointed for their knowledge of ophthalmology, but for their acquaintance with some branch of medicine, often the neurological. The need was for ophthalmic physicians who would do their own work, who would have to live, so to speak, with their ophthalmic failures.

Among the instances in which the medical study would be valuable that he gave were: 1. Various vascular conditions associated with changing blood pressure, arteriorsclerosis, vascular degeneration, thrombosis, and conditions associated with renal, hepatic, and cardiac diseases. 2. Diseases of the central nervous system, not only the gross and obvious ones, but such obscure ones as unexplained optic atrophies, headaches of, apparently, visual origin but without ocular defects. 3. The toxic and septic conditions causing ocular diseases, such as iridocyclitis, concerning which knowledge was in an unsatisfactory state. Such cases were at present referred to the consulting physician, dentist, pathologist, etc., and after a negative report had been received from them all, the case returned for empirical treatment, whereas it ought to come back to the physician, who should "live with" it until he had found a cause. There was great need for improved training in research from the medical side. Lastly, he mentioned various nutritional diseases, giving rise to corneal ulcers. Education as surgeons seemed to dull keenness and the power of investigating primary causes of certain ophthalmic problems: there was a hesitancy to stray beyond the orbit. In the case of cataract, in the ultimate issue operation could be done to relieve the worst of the symptoms: most of the systems of treatment depended on some local application to the eye, and were not based on investigation as to the cause. The fact that some cataracts would start rapidly and, after reaching a certain stage, become quiescent, pointed to some constitutional cause, one beyond the present power of recognition by surgeons. And he did not see how any thoughtful man could be satisfied with either the surgical diagnosis or treatment of many cases of glaucoma. There were a number which defied surgical treatment, and did not exhibit any of the ana-

tomical causes, yet they progressed. Moreover some of the acute cases showed a virulence for which no anatomical explanation sufficed. He did not consider it was creditable to the ophthalmologist that, glaucoma having occurred in one eye, he was unable to prevent its onset in the other, except by operation. The attitude of the specialty towards detachment of the retina was even more hopeless.

The prime fault in this matter lay in the present system of educating the ophthalmologist, who was required to pass the highest examination in general surgery, a large part of which had no bearing on eyes: his time would be better spent in acquiring some knowledge of medicine and of his own specialty. At present, a man might work ten or fifteen years at a leading ophthalmic hospital without doing a major ophthalmic operation. His skill in this must be gained in the school of experience, which was expensive alike to surgeon and patient.

It was undesirable to attempt to teach operative work to all the young men passing through the hospitals seeking ophthalmic training: it would be unjust to both patients and the hospital to attempt to do so. Ophthalmic surgery differed from all other surgery in that there was, in it, no gradual road to competence: one could not allow a man to *begin* an operation, such as that for cataract, and, if he got into difficulties, step in and set things right. The mischief was already done—and men had only two eyes. The present position, he declared, was not fair to the public, nor to the honor of ophthalmic surgery: he would have ophthalmic operations in fewer hands than at present. This would mean not only a higher standard by operative skill, but enterprise and progress in surgical treatment. It would then be possible to have private ophthalmic hospitals, equipped for these special operations: this would be much preferable to having to depend on nursing homes, where eye operations were infrequent, and the nursing means not satisfactory.

In place of the Fellowship he would have an ophthalmic qualification, and it should be possible to qualify either medically *or* surgically, for the latter there must be evidence of operative skill. For the ordinary medical qualification, men were required to have attended 20 or 30 cases of midwifery: was it too much to ask that before a man was admitted as an

ophthalmic surgeon he should show some operative skill in this department?

Physicians could be appointed to ophthalmic hospitals at once: they should attend out-patients, and have beds at their disposal. They should see all classes of cases, but should be relieved of all operative work. Both physicians and surgeons would benefit greatly by constant close association, and the system he advocated would redound to the credit and advancement of ophthalmology.

The paper will be debated at the next meeting of the Section.

REPORT OF THE PROCEEDINGS OF THE SECTION ON OPHTHALMOLOGY OF THE NEW YORK ACADEMY OF MEDICINE.

By Dr. ELLICE M. ALGER, Secretary.

MONDAY EVENING, OCTOBER 20, 1919. DR. ARNOLD KNAPP, CHAIRMAN.

After the reading of the minutes of the last meeting, Dr. Carl Koller presented a patient with **megalo-cornea,** on whom he had successfully performed a **cataract extraction.**

Dr. M. J. Leavitt showed a patient (previously shown) with **recurrent paralysis** of the **right external rectus,** there having been thirty attacks within the last twenty years.

Dr. Martin Cohen presented a patient with a large **implantation cyst of the iris.**

Male 32 years old. Received injury to the right eye by being struck with a chip of steel from a tool three years ago. He was at once taken to the Binghamton Hospital for X-ray examination to localize the foreign body. This examination was negative. The patient complained of pain and returned to his physician after four weeks when a piece of steel of hair-like caliber a ¼ of an inch long was removed from the nasal side of the corneoscleral margin with forceps. The aqueous at once exuded from the wound when the foreign body was removed. Slight pain recurred now and then after its removal.

The patient first presented himself at the Manhattan Eye and Ear Hospital on the service of Dr. David Webster about a week ago, who made a diagnosis of implantation cyst of the iris of traumatic origin. The patient complains of intermittent pains in the eyeball and deterioration of vision. Examination of the right eye revealed the following: moderate external deviation of the eyeball. No evidence of any extra-

ocular inflammation or tenderness of the eyeball on palpitation was present. Vision equaled motion of the fingers at two feet; light projection was normal and prompt in either direction, intraocular tension was eighteen with the Schiotz tonometer. At the nasal side of the sclerocorneal margin, there is seen a dense scar. The anterior chamber is of normal depth on the temporal side, but on the nasal side it is occupied by a large cystic tumor of mother of pearl appearance and translucent, probably due to a down growth of corneal epithelium which is implanted on the iris, and there goes on to proliferation and then degeneration. The anterior wall of the mass comes apparently close to the posterior wall of the cornea. On the inner wall of the mass one sees four sacculated indentations. The beginnings of these sacculations are bordered with retinal pigment extending slightly over the mass above and below. The posterior aspect of the mass is difficult to discern. The contents of the mass consist of granular detritus, fibrous elements, a few tinged with pigments, and fine strands of tissue extending from the sacculated indentations. Here and there is some pigmentary detritus. By transillumination one perceives a reddish reflex over the area of this mass, indicating that the pigment epithelial layer has become degenerated and absorbed and then replaced by the proliferated epithelium which lines the cyst wall. The pupil does not react either directly or indirectly. Its shape is slitlike and elliptical. The lens is cataractous and shrunken.

The question of operation or conservative treatment must be considered. Removal of the cystic mass by incision near the mass and then withdrawal of the cyst wall with forceps with excision might be considered, but owing to its large size it is questionable whether one or several operations would be practical. Eventually enucleation might be imperative.

DISCUSSION: Dr. JOHN E. WEEKS spoke of a somewhat similar case in which he had succeeded in removing the wall of the cyst with forceps and preserved the eyeball.

The subject of the evening, **Postgraduate Instruction in Ophthalmology,** was opened by Dr. MEYER WIENER of St. Louis with a paper on **experiences based on the recent military course in ophthalmology.** (Appears in this issue.) Dr. F. H. VERHOEFF of Boston, Mass., read the second paper on

some suggestions regarding the teaching of ophthalmology. (Appears in this issue.)

DISCUSSION.

Dr. EDWARD JACKSON of Denver. It is essential that the different subjects included in the graduate teaching of ophthalmology should be taken up in a certain logical order. We know that the undergraduate medical student is required to conform to a certain curriculum. He must study anatomy, physiology, pathology, and methods of diagnosis before he is allowed to follow clinical work. Only by such preparation for them can he profit to the fullest extent by the clinical opportunities that may be open to him. We should recognize that some such natural sequence of studies must be followed in preparation of the graduate for the practice of ophthalmology.

The undergraduate medical course does not give, and cannot give, the training in ocular anatomy, physiology, physiologic optics, ocular pathology, and methods of ocular examination, that are needed by one who undertakes special ophthalmic practice. But without them the time spent in following clinics cannot be used to the best advantage. These fundamental branches should precede the attendance on ophthalmic clinics.

With men well trained in the fundamental branches of general medicine and surgery, it is possible to give these fundamentals of ophthalmology in comparatively short courses of intensive training. But they should precede or come at the very beginning of clinical work if it is to be entirely helpful and satisfactory to the graduate student.

The need for this natural order in the graduate teaching of ophthalmology has been very imperfectly appreciated in the past. It would seem absurd to begin the general medical course with clinical study of any patient who happened to present himself, and to leave anatomy and pathology until later, or not require them at all. Yet something quite similar to this has been the common conception and practice in the graduate teaching of ophthalmology.

We should think this over carefully and then go out to do missionary work in the medical profession for this definite

rational arrangement of a curriculum for the teaching of this special branch. When young men begin to realize that this is the only proper course of study to fit them for ophthalmic practice, there will arise an effective demand for the right kind of teaching—that which is systematic, complete, and given in the natural and proper order.

Dr. G. E. DE SCHWEINITZ of Philadelphia said he desired to speak not of the ideal course, but of the practical possibilities. The student material could be divided into three general groups: (1) a very small group of well qualified men who were specializing in ophthalmology, (2) a group of men fairly well qualified who were simply desirous of brushing up or learning special lines of work, and (3) the large group of no special training.

These groups ought not to be mixed up for instruction, but should be graded by examination, so far as they will stand for it. One of the great difficulties will be that of securing adequate instructors, and it would be necessary to utilize the undergraduate teachers so far as possible. He described the ophthalmological part of the new post-graduate scheme of the University of Pennsylvania which is to begin with a short session next year and be expanded into a two-year course as rapidly as practicable. Dr. de Schweinitz emphasized his points: that he was thinking of the practical and not the ideal; that the present preliminary instruction as given in the undergraduate schools was very inadequate and that the great question is that of handling the students that present themselves to-day. He did not see any way except by grading them. There would be in his opinion no reason why any one need go to Europe for instruction in ophthalmology.

Dr. W. H. WILDER, Chicago: This subject is one that looms large at the present time among the problems of modern medical education, and conditions arising because of the war bring it prominently before us.

The importance of it has been forced upon the attention of the American Board for Ophthalmic Examinations, one of whose functions you may remember is to propose standards of fitness for the practice of ophthalmology and to suggest courses of study and preparation to the person who desires to take its certificate.

After 1920, the Board will require that candidates for its certificate who have practiced ophthalmology less than five years must have a degree from a college that requires four years of medical study and a fifth year of clinical or laboratory work. In addition the candidate must give evidence of a year of special study of ophthalmology under competent instructors and another year of interneship in an eye hospital or in lieu of this an assistantship in an eye clinic or a private assistantship with a competent ophthalmologist.

At the present time the opportunities and facilities for this extra year of special study of the eye under competent instructors are very few. Indeed, there are few places in this country to which a man can go for systematic study and preparation that will fit him for any specialty in medicine unless he is fortunate enough to get the personal attention of a master in that subject who will direct him and give him the special opportunities.

If anything the situation is somewhat more favorable in this regard in ophthalmology than in neurology, dermatology, pediatrics, and other specialties, but we must all realize that in ophthalmology the facilities that can be offered in this country for the preparation of persons to meet the requirements of our Board, reasonable as they seem, are lamentably weak and few.

I cannot agree with one of the speakers who stated his opinion that an interneship in a general hospital or some time of general practice is not a valuable fundamental preparation for the study and practice of ophthalmology. If such an interneship was in a hospital where the person served all his time on some special branch other than the eye, it naturally would not be as valuable as one in which he had the opportunities of a rotating service, but even at that if the service included medicine or surgery, dermatology or neurology, it seems to me that it could not help being of advantage to him.

The training he would receive in such a course would probably give him a broader view of pathologic processes and there would be less danger from the narrowing influence that special practice is apt to exert upon any individual.

In our scheme of post-graduate instruction in ophthalmology it seems to me we must provide for three classes of individuals. FIRST—those who have time to take a prolonged course of two

years or more in ophthalmology and its collateral subjects leading to some degree such as Ph.D. or S. M. Such courses might be provided for in the scientific schools and affiliated hospitals of the universities, which would naturally be the institutions to confer the degrees. But comparatively few would have the time or inclination to pursue such an extended course.

In the SECOND class will be those persons who desire to acquire a degree of proficiency and fitness that will make them safe practitioners of ophthalmology. On a good foundation they may build later skill and eminence.

The American Board for Ophthalmic Examinations thinks that this class should have a year of special study under competent instructors and a year of interneship in a special hospital or assistantship in a clinic or in private practice under a skilled ophthalmologist. Such a year's course should include fundamental branches such as anatomy, gross and microscopic of the eye and surrounding parts, embryology, pathology, bacteriology, physiology and physiologic optics, and these studies should be followed by the clinical subjects. Many persons may be unable to pursue such a course continuously for a year, and provision should be made so that certain subjects could be thoroughly covered in a given time. It would probably not be best to encourage courses of less than three months' duration.

Such instruction to be effective would have to be given to small classes or groups and this would necessarily require a large number of instructors. And right here will be encountered one of the great difficulties. How will the necessary number of men competent to give this instruction be obtained?

It will probably be some time before endowments will be forthcoming to support such technical instruction, and in the meantime the fees from students will have to furnish recompense for the instructors and meet other costs.

In the THIRD class for whom postgraduate instruction is required we find those persons who desire short courses of a few weeks at most, and who have no definite plans in their own minds of what they want, and have no time, ability, or inclination to follow any plan of intensive, sequential work that is offered them. Many of them are practitioners taking "brushing-up" courses, usually on the clinical side; many of them are men who have been failures in the practice of medicine and

think that ophthalmology is easy and can be acquired in a three weeks' course. Such persons are usually satisfied at the cheapest postgraduate schools.

This class presents no interest to us in the consideration of this problem of graduate instruction, for those in it who are earnest and sincere would probably find their way with the SECOND class if facilities for proper instruction were offered.

There are comparatively few centers in this country where proper facilities exist for carrying on this important work. Even in those, it seems to me, it will be necessary to combine the resources of medical schools, special hospitals, and clinics to get the most effective and desirable results. And this means there will have to be a hearty unselfish coöperation on the part of those competent to carry on the work if we hope to solve the difficult problem.

Dr. WALTER R. PARKER, of Detroit. I speak with some reluctance on the subject of postgraduate teaching, as my senior class consists of but one man, who has already spent two years on the ophthalmological service. The ophthalmic department in the University of Michigan is so arranged that we have a three-year progressive service, one year as interne, one as assistant, and one as demonstrator. The whole staff assists in the demonstration work given the undergraduate students and, in addition, the third-year man conducts the quiz in junior ophthalmology, which covers instruction in embryology, physiology, and anatomy, also the use of instruments. The lectures to the juniors are given by the Assistant Professor in Ophthalmology, who is a member of the permanent staff.

The increased interest in the work incident to the teaching has been one of the outstanding features of the experiment, and the necessity of preparation has resulted in a better knowledge of the fundamental branches than might otherwise have been acquired.

To arrange a schedule of subjects to be taught is much easier than to provide the proper facilities for presenting the work required. Short courses given to students who are unequally qualified are most unsatisfactory, and it seems to me should be discouraged. When all that was asked of the student was to observe clinical work for a few months, it was a very different

matter from requiring him to have a thorough knowledge of the fundamental branches of the subject as well as a clinical experience.

My experience as well as my observation leads to the conclusions that very little attention is paid to teaching the fundamentals to members of the resident staff. Much could be done by requiring each member to spend some time in the laboratories before being given clinical or ward work. A member of the staff or, after the plan is developed, the senior House Surgeon could give a systematic course in the fundamental branches of ophthalmology. Teaching institutions probably offer the best opportunity for giving the fundamental work leaving to the special hospitals the clinical teaching. It would seem in New York, a combination could be formed that would offer ideal opportunities for a complete course that would accommodate a large number of students.

The admirable plan as outlined by Dr. de Schweinitz to be developed at the University of Pennsylvania will offer a great opportunity for postgraduate work. I hope the courses will soon be extended to two years.

While the plan as developed at the University of Michigan during the past ten years is applicable to a very limited number, and may require many modifications, it is working out well however and may prove applicable to other teaching centers.

Dr. JOHN E. WEEKS laid stress on the desirability of a good knowledge of general medicine on which to build the superstructure of a specialty in medicine, and advocated a postgraduate interneship in some good general hospital or its equivalent. The postgraduate studies for the practice of ophthalmology should include embryology, special anatomy, normal and pathological histology of ocular tissues and physiological optics. The clinical training and the studies of refraction, ophthalmoscopy, surgical technique, etc., could then be added to the best possible advantage. The desired instruction in all its elementary phases can be best supplied by a large teaching body such as is found in our large universities, the various departments supplying the necessary instructors. Dr. DE SCHWEINITZ has outlined the ideal plan, and its development under his masterful direction will greatly aid those who aspire

to acquire a sufficiently comprehensive knowledge of ophthalmology.

Dr. ALEXANDER DUANE emphasized the points made by some of the other speakers as to the value or the importance of various fundamental parts of ophthalmology which were more often taken for granted than taught and of the necessity of planning a course so that one detail led logically up to the next. After the fundamentals should come groups of symptoms and then the clinical work. The best teaching was that which was most individual and therefore the classes should be small and carefully graded as to ability while the teaching itself might well be a combination of lecture demonstration and quiz. He thought the making and study of case reports might be of great value.